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EFFECTS OF PROTECTIVE CLOTHING ON PERSONNEL

PERFORMANCE—ANNOTATED INDEX

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SUMMARY

This review of open literature sources and Department of Defense research gives a good indication of the work that has been performed to ascertain how the wearing of protective clothing affects task performance.

Most research to date has concentrated on how infantry and aircrew perform when required to use protective gear. Far and away, most studies have investigated purely physiological performance degradation, while only a relative few have delved into potential psychological problems. Numerous determinations have been made on the effects of protective clothing in general on overall task performance, and additional research has been directed specifically toward ascertaining the effects of goggles, masks and respirators, and gloves.

Significant recent published literature has originated from the Army Aeromedical Laboratory at Ft. Rucker, Alabama; the Army Combat Developments Experimentation Command at Ft. Ord, California; the Army Human Engineering Laboratory at Aberdeen Proving Ground, Maryland; and from various U.K. establishments, most notably the Army Personnel Research Establishment at Farnborough.

The many studies that detail the rise in budy temperature that often accompanies the wearing of protective clothing have not been included here unless they also describe how personnel performance is affected. However, a number of discussions on various means of reducing the thermal stress of personnel are cited in the Appendix.



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SANJ-77-2132 EFFECT OF IMPERMEABLE CLOTHING AND RESPIRATOR ON WORK PERFORMANCE: 04-78 PT. 1, LABORATORY STUDIES (U), 47 P., (U) SSD66-332(618) PERFORMANCE MEASURES FOR HUMAN FACTORS ENGINEERING EVALUATION OF 06-66 092 EARL EQUIPMENT (U), 149 P., (U) STUDY-R.12 062 COST OF PRODUCTION SENSITIVITY TESTS (U), 29 P., (FOREIGN 01-67 RESTRICTED) T5-900/3111 EFFECT OF FLIGHT GLOVES AND METHOD OF DATA ENTRY ON SPEED AND 05-65 050 ACCURACY OF POSTTIONING THUMBWHELL SWITCHES (U), 19 P., (U) TDCK-75013 EVALUATION OF CHEMICAL PROTECTIVE FACLETS AND COMPARISON OF FOUR 00-80 042 PROTOTYPES (U), 21 P., (U) USA-NLABS-TR-73-35-PR DEXTERITY AFFORDED BY CB PROTECTIVE GLOVES (U), 41 P., (U) 089 03~73 USAARL-82-9 PERFORMANCE IMPACT OF CURRENT UNITED STATES AND UNITED KINGDOM 09-82 019 AIRCREW CHEMICAL DEFENSE ENSEMBLES (U), 44 P., (U) USAARL-83-4 PHYSIOLOGICAL IMPACT OF WEARING AIRCREW CHEMICAL DEFENSE PROTECTIVE ENSEMBLES WHILE FLYING THE UH-1H IN HOT WEATHER (U). 020 10~82 84 P., (U) USAARL-83-6 PSYCHOLOGICAL EFFECTS OF CHEMICAL DEFENSE ENSEMBLE IMPOSED HEAT 11-82 08.1 STRESS ON ARMY AVIATORS (U), 34 P., (U) USAARL-83-7 PSYCHOLOGICAL MEASUREMENTS DURING THE WEAR OF THE US AIRCREW 02-83 017 CHEMICAL DEFENSE ENSEMBLE (U), 54 P. (U) USACDCEC-60.3 OPERATIONS IN A TOXIC ENVIRONMENT (U), 160 P., (U) 04-68 USAFSAM-TR-84-28 COMPARATIVE VISUAL PERFORMANCE WITH ANVIS (AVIATOR'S NIGHT VISION 08-84 IMAGING SYSTEM) AND AN/PVS-SA NIGHT VISION GOGGLES UNDER 047 STARLIGHT COMDITIONS (U), 23 P., (U) USAFSAM-TR-85-24 GROUNDCREWS TEST CHEMICAL WARFARE ENSEMBLE WITH AND WITHOUT 06-85 066 LIQUIDCONDITIONED GARMENTS (U), 21 P., (U) USARIEM-M-18/86 FACTORS LIMITING ENDURANCE OF ARMOR, ARTILLERY, AND INFANTRY UNITS 03-86 048 UNDER SIMULATED NBC CONDITIONS (U), 15 P., (U) USARIEM-M-4/86 EFFECT OF HEAT AND CHEMICAL PROTECTIVE CLOTHING ON COGNITIVE 11-85 079

PERFORMANCE (U), 27 P., (U)

SECTION 6

FULL CITATIONS

001 TITLE EFFECT OF IMPERMEABLE CLOTHING AND RESPIRATOR ON WORK PERFORMANCE;

PT. 1, LABORATORY STUDIES (U), 47 P., (U)

AUTHOR CORP PEPART AVAIL

P.B. Mossman and H.A. Atterbom Sandia Labs (Albuquerque, NM)

SANO-77-2132

DATE

Available from NTIS as N79-11748

0478 ABSTRACT

Work performance with impervious clothing and full-face respirator was investigated during maximal and submaximal (40 to 60%) bicycle ergometer efforts. Such levels would be required of attack teams during an assault on security systems designed to mandate the use of vapor barrier clothing (VBC) and respirators. Five different exercise protocois were administered. Heart rate (HR), oxygen consumption (V/sub 0/sub 2/), and skin and rectal temperatures (T/sub s/ and T/sub r/) were monitored. The impervious suits resulted in decreased work performance, aerobic metabolism, and tolerance time. Stress indices of HR and mean T/sub s/ were found to be correlated with these differences. The study demonstrates that a security system using a chemical deterrent places a physiological stress of considerable magnitude on an adversary group. Follow-on field studies have been conducted to relate the conclusions of these laboratory studies to field conditions. The results of the field studies will be reported in Part 2.

TITLE

EFFECTS OF TEMPERATURE AND PROTECTIVE CLOTHING UPON TASK COMPLETION TIME, WORK QUALITY, AND STUDENT PERCEPTIONS OF THE LEARNING ENVIRONMENT (U), 124 P., (U)

AUTHOR CORP SYMURL DATE

ABSTRACT

U. of Missouri, Columbia

S R Burke

Dissertation Abstracts International, Vol. 41/11A, page 4580

0080

Much has recently been said about the energy problems facing this country. The literature revealed that most recommendations about optimum cool weather temperatures for vocational laboratories were based upon industrial studies. Some researchers suggested that laboratory temperature may be reduced to 55(DEGREES)f or lower if protective clothing is worn. Others noted that students have their own set of environmental requirements for thermal comfort and may differ from the teacher requirements. The purpose of this study was to ascertain the effects of temperature and protective clothing upon student performance and perceptions toward the learning environment. Hypotheses were: (1) There is no significant difference between group mean task completion times at different laboratory environmental temperatures. (2) There is no significant difference between group mean scores on task completion time for students who wore protective clothing and those who did not at different laboratory environmental temperatures. (3) There is no significant difference between group mean work quality scores at different laboratory environmental temperatures. (4) There is no significant difference of the state of the stat rence between group mean work quality scores for students who wore protective clothing and those who did not at different laboratory environmental temperatures, (5) There is no significant difference between group mean scores on perceptions toward the learning environment at different laboratory environmental temperatures. (6) There is no significant difference between group mean scores on perceptions toward the learning environment at different temperatures and levels of protective clothing. The study population consisted of students in the 23 schools of the Blue Ridge supervisory area of Virginia that offered the course Agricultural Science and Mechanics I. The sample consisted of 197 Students from twelve schools and fifteen classes. A cluster sampling procedure was employed in selecting the sample. Students within each class were randomly assigned to Experimental Group I, Experiment Group II, or Control Group III. After one

day of classroom instruction students were asked to construct a project in the agricultural mechanics laboratory under a ran-domly assigned temperature of 50(DEGREES)F, 60(DEGREES)F, or 70(DEGREES)F. Group I students constructed the project without protective clothing while Group II students wore coveralls. Group III students performed the same task at a 67(DEGREES)F temperature without protective clothing. Measurements of task completion time, work quality, and perceptions toward learning environment were taken. The experimental materials were prepared by the researcher. The experiment was a posttest only control group design. One-way and two-way ANOVA and MANOVA procedures were used to analyze the data. A one-way ANOVA was used to analyze the influence of temperature upon task completion time and work quality mean scores, separately. No significant differences were found and hypotheses 1 and 3 were accepted. A two-way ANOVA was used to analyze the influence of temperature and protective clothing upon task completion time and work quality. No significant differences were found among the group mean scores and hypotheses 2 and 4 were accepted. A MANOVA procedure was used on the group mean scores to analyze the influence of temperature and temperature and protective clothing upon perceptions toward the learning environment. Significance was found at the .05 alpha level and hypotheses 5 and 6 were rejected. Eased on the findings and limitations of this study, it was concluded that temperature and protective clothing do not influence task completion time and work quality in temperatures as low as 509(DEGREES)F during forty minutes of exposure. However, perceptions toward the learning environment are affected by temperature and temperature and protective clothing. The most favorable perceptions occur at 67(DEGREES)F and 70(DEGREES)F.

003	TITLE	EFFECT OF WEARING CHEMICAL PROTECTIVE CLOTHING IN THE HEAT ON SIGNAL DETECTION OVER THE VISUAL FIELD (U)
	AUTHOR	J.L. Kobrick and L.A. Sleeper
	CORP	Army Research Institute of Environmental Medicine (Natick, MA)
	SYMURL	Aviation, Space and Environmental Medicine, 1986 Feb Vol. 57(2)
	DATE	0086
004	TITLE	PHYSIOLOGICAL STRAIN IN WORK WITH GAS PROTECTIVE CLOTHING AT LOW AMBIENT TEMPERATURE (U)
	AUTHOR	J. Smolander, V. Louhevaara and O. Korhonen
	CORP	Institute of Occupational Health, Dept. of Physiology (Vantaa, Finland)

1285

SYMURL

ABSTRACT

DATE

Wearing an impermeable gas protective suit (Drager 500 or 600) and a self-contained breathing apparatus (Drager PA 80; total weight 27 kg (59.5 lb), seven experienced firemen and one mechanic performed simulated repair and rescue tasks in a chemical plant. The subjects' mean (+/-SD) age, height, weight and estimated maximal oxygen consumption were: 36 + /-4 years; 181 + /6 cm; 83 + /-8 kg; and 42 + /-5 mL/min/kg, respectively. The operations took place outdoors (ambient temperature 2.0 degrees C (35.6 degrees F), wind velocity 0-4 m/s). The total work time averaged 37 minutes. During tasks of search, handling vents, and sawing and replacing bolts, the mean (+/-SE) heart rates measured by a handling vents, and sawing Depex recording device were 146 +/-2, 148 +/-2, and 147 +/-5beats/min, respectively. The mean rectal temperature increased O.8 degrees C during the whole work period. Weight loss due to sweat averaged 300 g. In conclusion, typical tasks with gas protective clothing caused marked physiological strain among subjects in average physical condition even though the thermal strain was relatively low because the weather was cool. The results emphasized the need to evaluate physical fitness during the periodic check-ups of workers who may have to used gas protective clothing.

Am Ind Hyg Assoc J. 46 (12) Pp. 720-723, ISSN 0002-8894

005	TITLE AUTHOR ORIGIN Symurl Date	FORCE CAPABILITY DIFFERENCE DUE TO GLOVES (U) D.J. Cochran and C.A. Schanbacher England Ergonomics (ENGLAND), Feb 1985, 28 (2) Pp. 441-447, ISSN 0014-0139 0285
006	TITLE	REDUCTION OF ISOMETRIC MUSCLE ENDURANCE AFTER WEARING IMPERMEABLE GAS PROTECTIVE CLOTHING (U)
	AUTHOR Symurl Date	J. Smolander, V. Louhevaara, T. Tuomi, D. Korhonen and J. Jaakkola Eur J Appl Physio, 1984, 53 (1) Pp. 76-80, ISSN 0301-5548 0084
	ABSTRACT	The isometric ordurance of forearm muscles at 40% maximum voluntary contraction was measured in six healthy male subjects, after they had walked for 25-30 min on a treadmill while wearing an impermeable gas protective suit and a self-contained breathing apparatus at a light (21% VO2 max), and a moderate 41% VO2 max) work level. The mean endurance times were 12% (NS) and 24% (P less than 0.01) shorter than the average control value after exercise for the light and moderate work levels, respectively. These changes were accompanied by an increased heart rate, and rectal and skin temperatures. Ventilating the suit with an air flow of 181 min-1 at the moderate work level did not sign ficantly affect isometric endurance (decreased 27%), heart rate or body temperatures. It was concluded, that muscular performance capacity is reduced after wearing gas-protective clothing in a temperate environment, presumably due to the increased muscle temperature, and this should be considered in scheduling work times and rest periods.
007	TITLE	PHYSIOLOGICAL EFFECTS ON WORK PERFORMANCE ON VAPOR-BARRIER CLOTHING AND FULL-FACE RESPIRATOR (U) H.A. Atterbom and P.B. Mossman
	SYMJRL DATE ABSTRACT	J Occup Med, 1978 Jan, 20 (1) Pp. 45-52, ISSN 0096-1736 0178 Work performance with impervious clothing and full-face respirator was investigated during maximal and submaximal (40-60%) bicycle ergometer efforts. Such levels may be dictated by the requirements of emergency deconcontamination tasks while most studies have been concerned with lower levels of activity. Five different exercise protocols were administered. Heart rate (HR), oxygen consumption (Vo2), skin (Ts) and rectal (Tr) temperatures were monitored. The impervious suits results in decreased work performance, aerobic metabolism, and tolerance time. Stress indices or HR and mean Ts were found to be correlated with these differences. The study is being expanded for the purpose of establishing safe physiological guidelines for work tolerances at higher energy levels in impermeable suits.
008	TITLE	SELECTED FACTORS AFFECTING AIRCREW PERFORMANCE DURING SUSTAINED OPERATIONS (U), 17 P., (U)
	AUTHOR CORP	K.A Kimball Army Aeromedical Research Lab., Biomedical Applications Research Lab. (Ft. Rucker, AL)
	AVAIL	Available from NTIS as N84-21074; Available from DTIC as AD PO02990; Available from AIAA Technical Library
	SYMURL	AGARD Conference, Sustained Intensive Air Operations (See Item 015 [NTIS N84-21062; DTIC AD A139324]); PP. 20-120-17
	DATE ARSTRACT	Six graduates of initial rotary wing training flew a UH-1H helicopter for up to 4 hours while wearing each of clothing ensembles. Each aviator wore the standard flight suite, the US chemical defense (CD) ensemble, and the United Kingdom (UK) CD ensemble in hot weather (mean WBCT 29 C). Skin temperatures (chest, thigh, upper arm, and cslf) rectal temperature, heart rate, and preflight and postflight body weights were recorded. Cognitive testing was conducted preflight, postflight, and on

nonflight days. Aviator performance measures were also obtained during flight. Well acclimatized aviators were able to fly at least 2 hours without serious physiological impairment. Three of aviators terminated flight for modical reasons (heart rates 40 bpm or nausea) while wearing the US ensemble. The susceptible subjects tended to be older and heavier. Heart rate was judged to be the most sensitive indicator of heart stress. Cognitive testing and flight performance data obtained during this exercise did not demonstrate changes as a function of the type of flight ensemble worn during the test, nor did flight performance serve as a predictor of heart stress,

009 TITLE

AUTHOR CORP

SYMURL

THERMAL CONTROL PROBLEMS IN MILITARY HELICOPTERS (U), 10 P., (U)

J.R. Allan

Royal Air Force Institute of Aviation Medicine (Farnborough,

[England]) ORIGIN

United Kingdom AVAIL

Available from NTIS as N84-26286; Available from AIAA Technical Library

AGARD Conference, Aeromed. Support in Mil. Helicopter Operations

(NTIS N84-26279)

DATE

ABSTRACT

0484 The origins of thermal problems in military helicopters are discussed and compared with those of fixed wing aircraft. Some typical helicopter sortie temperature profiles are presented for hot and cold environments. The environments for protection from chemical warfare agents are described in relation to helicopter operations and the additional thermal problems arising from chemical protective assemblies and drills are described. Potential adverse effects on aircrew performance and fatigue are considered. Thermal hazards in post crash survival situations are also considered particulary those related to ditching cold water. Various approaches to the relief of thermal stress in helicopter aircrew are considered. The limitation of engine powered environmental control systems and the potential advantages of personal conditioning systems are described. The advantages of liquid conditioned systems are compared with air systems. Cold environment protection is described in terms of insulation and water exclusion and the role of electrically heated garments is described.

010 TITLE

CONTRACTOR DESCRIPTION OF THE PROPERTY OF THE

IDENTIFICATION OF AN APPREHENSION EFFECT ON PHYSIOLOGICAL INDICES OF THERMAL STRAIN (flight protective ciothing evaluation) (U) . M.H. Harrison and C. Saxton

AUTHOR CORP

United Kinadom

RAF, Institute of Aviation Medicine (Far borough, Hauts., England)

ORIGIN AVAIL SYMURL

ABSTRACT

Available from AIAA Technical Library

Aviation, Space, and Environmental Medicine, Vol. 47, Sept 1976, Pp. 950-953

DATE 0976

> Experiments were conducted on eight male subjects aged 24-37 yr to evaluate the additional thermal strain produced when a protective clothing assembly (PCA) was worn in addition to a normal flying clothing assembly (FCA)> The experimental design adopted involved condition replication, i.e., each subject in the evaluation took part in two 'control' (FCA only) and two 'test' each subject in the (FCA+PCA) experiments. The measurements concerned climatic factors, deep body temperature, skin temperature, and heart rate. The data were analyzed by analyses of variance of the absolute values of each physiological measure, and also in increments above the mean of steady-state measurements made during the last the rest period. It is shown that condition replication revaled a significant apprehension effect which confounded the physiological variables used to evaluate the thermal strain. leading to an overestimation of the severity of thermal strain. In addition, there was a large between-subject variation among tre eight subjects, which made the arithmetic mean a potentially

misleading statistic for evaluating the increased physiological strain caused by PCA during heat exposure.

TITLE 011

DESIGN OF WORKING SYSTEMS ON ERGONOMIC PRINCIPLES. THE IMPORTANCE OF CLOTHES AND PROTECTIVE EQUIPMENT IN THE DESIGN OF THE WORKPLACE (U), 7 P., (U)

REPORT

HSE-TRANS-10865: DIN-33-400-SUPPL-7: FNERG-AA-10-30A-77:

FNFRG-AA-2-144-77

ORIGIN

Federal Republic of Germany

AVAIL

Available from AIAA Technical Library

SYMURL

Transl, into English from Deut. Inst. fuer Normung (West Germany),

Vol. 33 No. 400 Suppl. 7, Aug. 1977, 7 p.

DATE

ABSTRACT

Those criteria which determine the effects of clothing and protective equipment on body dimensions, the changes in center of gravity due to protective gear, the effects of this equipment on performance and on the risk of accident are discussed.

012

TITLE

PREDICTION OF AIRCREW PERFORMANCE UNDER DIFFERENT ENVIRONMENTAL

CONDITIONS (U), 9 P., (U)

AUTHOR CORP

E.H. Wissler and S.A. Nunneley Texas U. (Austin TX) and AF School of Aerospace Medicine (Brooks

AFB. TX) N

0585

REPORT

SAF Paper 840939 Available from AIAA Technical Library

AVATL. SYMURL

14th Intersociety Conference on Environmental Systems, July 16-19,

1984, San Diego, CA

DATE ABSTRACT

If thermal problems are to be avoided in both military and commercial aviation, a rational procedure is required for aviation, a rational procedure is required for evaluating the effect of various environmental parameters on the condition of aircrew members. In this paper, the authors describe a computer model which has been shown to predict accurately human thermal responses over a wide range of conditions. The model allows one to evaluate the effect on aircrew members of important parameters, such as the work profile, regional and temporal variation in windspeed, temperature, and solar load, and the type of garment worn. It is also possible to simulate the use of liquid cooled garments to reduce thermal stress, and the effect of immersion in cold water. Representative applications involving three different situations are presented in the paper.

013

TITLE

EVALUATION OF OLEFIN ANTI-EXPOSURE LINERS FOR THEIR EFFECTS ON THE OPERATIONAL PERFORMANCE AND SURVIVAL OF NAVAL AIRCREWMEN (U)

AUTHOR

CORP

Naval Air Development Center, Aircraft and Crew Systems Technology Directorate (Warminster, PA)

AVAIL

Available from AIAA Technical Library

S.M. Reeps and J.W. Kaufman

SYMURL DATE

SAFE Journal, Vol. 15, Spring 1985, Pp. 22-28 0085

ABSTRACT

Olafin anti-exposure liners, worn as part of a constant wear antiexposure assembly, have been evaluated at the Naval Air Development Center to determine their levels of performance in the areas of mobility/reach, heat stress/comfort, and immersion hypothermia protection. Mobility/reach measurements were made using an anthropometric measuring device specifically constructed to measure movements required of aircrewmen operating aircraft. Heat stress testing consisted of three hour exposure in 35 C air while subjects repeated a 20-minute cycle of work, psychomotor tracking, and rest. Immersion hypothermia testing was conducted in 7.2 C water, O C air, and 24-32 kph winds, with maximum exposure time set at two hours. Two liner configurations, differing in the extent of body-extremity coverage, were evaluated and compared to the current CWU-23/P Anti-exposure liner. Both configurations are fabricated of 100 percent olefin--microfiber insulation sandwiched between layers of woven high--

temperature resistant aramid fabric for fire protection. The results are discussed in terms of the U.S. Navy Operational Requirement for cold water protection, as currently specified by CNO. A review of related evaluations conducted at other facilities is also provided and discussed.

TITLE 014

LABORATORY STUDIES OF AIRCREW CHEMICAL PROTECTIVE ENSEMBLE: EFFECTS ON PILOTS' PERFORMANCE (U), 18 P., (U)

AUTHOR

G.R. McMillan, W.J. Cody and R.G. Mills

CORP

McDonnell-Douglas Astronautics (Huntington Beach, CA) and Aerospace Medical Research Labs., Human Engineering Div. (Wright-Patterson AFB, OH)

AVAIL SYMURL Available from NTIS as N84-21066; Available from DTIC as AD PO02984; Available from AIAA Technical Library

AGARD Conference, Sustained Intensive Air Operations (See Item 015 [NTIS N84-21062; DTIC AD P002983]); Pp. 7-1--7-18

DATE

0083 ABSTRACT

The results of a U.S. Air Force program designed to quantify the effects of current and near-term chemical protective gear on pilot performance are described. The first phase of the program consisted of a sensitivity analysis to determine which aspects of pilot performance should be evaluated, the anticipated performance decrements, the stress mechanisms presumed to be operating, and the flight simulations required to quantify the effects of the protective ensemble. To date, two full-mission laboratory experiments have been completed. These experiments evaluated the currently fielded USAF aircrew ensemble and a proposed Integrated Chemical Defense System. Reductions in pilot performance were observed with both systems under simulated hot environmental conditions. However, the pilots strongly preferred the Integrated Chemical Defense System's eye-respiratory protective gear. The data suggest that thermal stress, produced by the multiple layer body protective gear, caused the performance reductions. The experimental data are being further analyzed with appropriate mission and effectiveness models.

015

TITLE

SUSTAINED INTENSIVE AIR OPERATIONS: PHYSIOLOGICAL AND PERFORMANCE ASPECTS (U), 220 P., (U) (Conference held in Paris, 18-22 Apr

Aerospace Research and Development

CORP

DATE

Ivisory Group for Aerospace
(Neuilly-SurSeine, [France])

AGARD-CP-338; ISBM-92-835-9343-0

REPORT ORIGIN

France

LANG

English \$ French

Advisory

AVATL

Available from NTIS as N84-21062; Available from AIAA Technical

Library

1183

ABSTRACT

The symposium addressed the aeromedical and human factors aspects of the capabilities of aircrew and ground crew to perform their duties at high intensities at irregular times of the day and night over many days or weeks under military operational conditions. Laboratory studies on the measurement of aircrew worklod, the effects of disturbances of circadian rhythms and deprivation of sleep and the use of hypnotics and stimulants to influence sleep and wakefulness are reported. The effects of protective equipment and procedures on air and ground crew with particular reference to fast jet and helicopter operations are examined Field studies of fatigue, performance and physiological disturbances in aircrew and ground personnel engaged in sustained air operations are described. For individual titles, see N84-21063 through N84-21081

016

TITLE

MISSILE COMPONENT REPAIR WHILE WEARING NBC PROTECTIVE CLOTHING

(U), 50 P., (U)

AUTHOR

J.D. Waugh and P.W. Kilduff

CORP Human Engineering Labs. (Aberdeen Proving Ground, MD)
REPORT HEL-TM-1-84

AVAIL Available from NTIS as N84-20180; Available from DTIC as AD A137315; Available from AIAA Technical Library

DATE 0184

DATE ABSTRACT

The US Army Human Engineering Laboratory assessed possible degradation in the performance of missile repair persons while wearing NBC protective clothing. Nine male soldiers, just graduated from the Advanced Individual Training Course in Missile Repair, were required to perform repair tasks in three replications. Two repair tasks were chosen; one considered nondifficult whose activities concentrated on procedural diagnostics and fault isolation; the second considered difficult, required manipulaiting small machine parts and hand tools requiring fine eye-and coordination. The experimental results and subsequent comparative statistical analysis showed no degradation in performance of the easier procedures and diagnostic task. The time to complete the more difficult task was degraded (increased) on the average of 45% in MOPP 4 with a definite contribution to degradation attributed to the mask/hood and the protective gloves by themselves. A significant improvement attributed to learning from the first to the second presentation was found, but not from the second to the third presentation. The participants' degree of learning was neither enhanced nor held back while in protective clothing compared to working in the duty uniform.

O17 TITLE PSYCHOLOGICAL MEASUREMENTS DURING THE WEAR OF THE US AIRCREW CHEMICAL DEFENSE ENSEMBLE (U), 54 P. (U)

AUTHOR B.E. Hamilton and L. Zapata

CORP Army Agromedical Research Lab., Biomedical

Army Aeromedical Research Lab., Biomedical Applications Research Div. (Ft. Rucker, AL)

REPORT USAARL-83-7 AVA11. Available from NTIS

Available from NTIS as N83-28872; Available from DTIC as AD A125616; Available from AIAA Technical Library

DATE 0283 ABSTRACT The

TITLE

CORP

AUTHOR

ABSTRACT

018

The psychological (as opposed to physiological) effects of wearing a US aircrew chemical defense ensemble were evaluated using 12 male and 12 female volunteer. Half of the males and half of the females were chemical defense ensembles while the rest were standard US flight suits as controls. All subjects were administered tests of cognition (math, logical reasoning, target detection, and reaction time) before and after 6 hours of wear in a controlled environment. In addition, subjects rated their mood before and after wear. It was concluded that wearing the ensemble in an undemanding environment degraded affect (mood and activation levels), slightly decreased accuracy, and substantially decreased reaction times, especially in females. The most serious impact of the ensemble would seem to be a decrease in morale in females.

RESTRAINT BY CLOTHING UPON FIRE-FIGHTERS PERFORMANCE (U)

E.J.G. Vandelinde

Institute for Perception RVO-TNO, Soesterberg (Netherlands)
Netherlands

ORIGIN Netherlands
AVAIL Available from NTIS as N83-26472; Available from AIAA Technical

Library
SYMURL Research Inst. of National Defense Intern. Conf. on Protective

Clothing Systems, Pp. 195-204 (NTIS N83-26454)

Physiological strain caused by metabolic and environmental heat and fire protective clothing was studied. Six subjects performed light work on a treadmill in two different climates, wearing three different types of clothing. For each of the resulting 36 sessions heat balance was reconstructed and clothing parameters were calculated. Measurements show little difference in insulation but large differences are found in water vapor permeabi-

lity, ranging from 0.11 to 0.25. Poor permeability results in high heat strain, especially during moderately hot work or recovery periods. Predictions of tolerance time during a moderately not fire trail are shorter than measured. Differences in tolerance time between clothing are predicted correctly. A diagram that displays safe work time as a function of metabolic and environmental heat load is proposed.

019 TITLE PERFORMANCE IMPACT OF CURRENT UNITED STATES AND UNITED KINGDOM AIRCREW CHEMICAL DEFENSE ENSEMBLES (U), 44 P., (U)

AUTHOR

B.E. Hamilton, D. Folds and R.R. Simmons

CORP

Army Aeromedical Research Lab., Biomedical Applications Research Div. (Ft. Rucker, AL)

REPORT AVAIL

USAARL-82-9

Available from NTIS as N83-20570; Available from DTIC as AD

A121502; Available from AIAA Technical Library 0982

DATE ABSTRACT

The ability of helicopter pilots to fly while wearing chemical defense (CD) ensembles in hot weather was investigated. Each subject flew on three separate days, wearning a different ensemble each day. The ensembles tested were the United States Army Aircrew chemical defense ensemble, the United Kingdom aircrew chemical defense ensemble, and the United States Army standard flight suit uniform. While subjects made statistically larger heading errors while wearing the US chemical defense ensemble, no operationally significant differences in performance were seen. It is concluded that a pilot's performance is not an indicator of heat stress.

020 TITLE PHYSIOLOGICAL IMPACT OF WEARING AIRCREW CHEMICAL DEFENSE PROTECTIVE ENSEMBLES WHILE FLYING THE UH-1H IN HOT WEATHER (U). 84 P., (U)

AUTHOR

F.S. Knox III, G.A. Nagel, B.E. Hamilton, R.P. Dlazabal and K.A. Kimball

COPP

Army Aeromedical Research Unit, Biomedical Applications Research Div. (Ft. Rucker, AL)

REPORT

USAARL-83-4 AVAIL

Available from NTIS as N33~18255; Available from DTIC as AD A121581; Available from AIAA Technical Library

DATE ABSTRACT

1082

Six recent graduates of initial entry rotary wind training flew a UH-1H for up to 4 hours while wearing each of three clothing ensembles. Each aviator wore the standard flight suit, the US chemical defense (CD) ensemble, and the United Kingdom CD ensemble in heat weather (mean WBGT 29 C). Skin temperatures (chest, thigh, upper arm and calf), rectal temperature, heart rate, and preflight and postflight body weights were recorded. Three of six aviators terminated flight for medical reasons (heart rates > 140 bpm of nausea) while wearing the US ensemble. Well acclimatized aviators in this study who did not preflight and drank water every hour were able to fly for at least 2 hours (one fuel load) before the most susceptible subjects had to terminate flight due to heat stress. Heart rate was the most susceptible subjects had to terminate flight due to heat stress. Heart rate was the most sensitive indicator of this stress. In this study, these susceptible subjects tended to be older and heavier. Although no measures cardiopulmonary fitness (e.g., V sub O2 max) were made, it may be that these susceptible subjects were somewhat less fit. The US ensemble was somewhat more stressful than the UK or standard ensembles. Subjectively all subjects preferred the AR5 respirator to the M24 mask, were divided on overgarment vs undergaremnt, and most disliked the US overboots. As a caveat it should be stated that fitness alone is not likely to be sufficient to overcome the heat stress induced by these ensembles as flight times are extended. Some sort of cooling will probably be needed.

021	TITLE	PHYSIOLOGICAL RESPONSES OF HUMAN SUBJECTS WEARING THERMAL PROTECTIVE CLOTHING ASSEMBLIES IN VARYING ENVIRONMENTS (U)
	AUTHOR CORP	D.C. Johanson, S.M. Reeps and L.J. Santamaria Naval Material Command, Naval Air Development Center (Warminster,
	SYMURL	PA) Proceedings of the Survival and Flight Equipment Association 17th Annual Symposium, Dec 2-6, 1979 held at Las Vegas, NV
	DATE	0080
	ABSTRACT	A group of representative free world anti-exposure suit configurations was selected for a test program designed to evaluate their relative effects on aviator performance in the areas of mobility loss, heat stress, and immersion hypothermia protection. Sequential testing was utilized to eliminate those configurations which did not meet predetermined requirements to satisfy the operational need of naval forces. Mobility loss and heat stress testing at 35 C have been completed. Immersion hypothermia testing in 7.2 C water is currently being conducted with tests in O C water to follow.
022	TITLE	THERMAL AND ACC PERATION EFFECTS ON AIRCREW MEMBERS IN CHEMICAL DEFENSE GEAR (U), 36 P., (U) R.E. Yates, C.R. Replogle and J.H. Veghte
	CORP REPORT	Aerospace Medical Research Labs. (Wright-Patterson AFB, DH) AFAMRL-TR-79-71
	AVAIL	Available from NTIS as N80-30045; Available from DTIC as AD A086026 0180
	DATE ABSTRACT	An experiment was conducted to determine the combined thermal and
	ABJIRACI	acceleration effects on aircrew members in chemical defense protective gear in a simulated air-to-ground mission. The subject flew two sorties per day in the Dynamic Environment Simulator. The environmental conditions simulated were typical of a 95th percentile hot summer central European day. Most of the responses seen in the subject can be attributed to the thermal stress caused by the hot temperatures and the heavy protective clothing.
023	TITLE	PATIENT CARE IN A CHEMICAL ENVIRONMENT SUB-STUDY: EFFECTS OF CHEMICAL PROTECTIVE CLOTHING ON THE PERFORMANCE ON BASIC MEDICAL TASKS (U), 52 P., (U)
	AUTHOR	J.M. King and A.J. Frelin
	CORP	Army Health Care Studies and Clinical Investigation Activity, HCS Div. (Ft. Sam Houston, TX)
	REPORT AVAIL	HCSD-83-001 Available from DTIC as AD A139001
	DATE	1282
	ABSTRACT	The purposes of this study were (1) to measure the ability of medical specialists to perform 9 selected basic medical tasks while in fatigue uniform, MOPP-4, or MCPP-4 with a tactile glove, (2) to measure learning effects on performance of these tasks, (3) to determine the degree of which the ability to perform the tasks is degraded by MOPP-4 or MOPP-4 with the tactile glove, and (4) to obtain preliminary durability and user satisfaction data on the tactile glove. Subjects performed the tasks in fatigues, MOPP-4 with tactile glove, and MOPP-4 for six consecutive duty days, thus each subject served as his/her own control. Subjects were able to perform all of the tasks under all conditions on all test days. Subjects improved their performance speed significantly, while making fewer errors. The bulk of the improvement in performance occurred in the first 3-4 days of the study in fatigues, MOPP with tactile gloves, and MOPP-4. At the end of the study, subjects functioned at 77% of fatigue level in MOPP with tactical gloves and at 64% of fatigue level in MOPP-4. It may be advisable to alter manning patterns in order to maintain work output. Tactical gloves significantly improved performance, but have relatively low durability, with

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15 of 18 damaged by the end of the study. They are of considerable value for tasks which require the extra dexterity.

024 TITLE FIREFIGHTERS INTEGRATED RESPONSE EQUIPMENT SYSTEM (U), 11 P., (U) AUTHOR H. Kaplan and F. Abeles CORP Grumann Aerospace Corp. (Bethpage, NY) REPORT ASME Paper 78-ENAS-39 AVAIL Available from AIAA Technical Library SYMURL American Society of Mechanical Engineers, Intersociety Conference on Enviornmental Systems, July 10-13, 1978, San Diego, CA DATE 0778 ABSTRACT The firefighters Integrated Response Equipment System (Project FIRES) is a joint National Fire Prevention and Control Administration (NFPCA)/National Aeronautics and Space Administration (NASA) program for the development of an 'ultimate' firefighter protection against hazards, such as heat, flame, smoke, toxic fumes, moisture, impact penetration, and electricity and, at the same time, improve firefighter performance by increasing maneuverability, lowering weight, and improving human engineering

design of his protective ensemble.

EFFECTS OF ENCUMBERING CLOTHING, PERSONAL-PROTECTIVE EQUIPMENT AND RESTRAINTS ON BODY SIZE AND ARM-REACH CAPABILITY OF USAF AIRCREWMEN (U), 4 P., (U)

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AUTHOR

M. Alexander, L.L. Laubach and J.T. McConville

CORP

Webb Associates (Yellow Springs, OH)

REPORT

AMRL-TR-76-118

025

026

TITLE

ABSTRACT

AVAIL Available from NTIS as N77-28746; Available from DTIC as AD A036682; Available from AIAA Technical Library

SYMURL Presented at the Aerospace Med Assoc Meeting Rel Harbour El

Presented at the Aerospace Med. Assoc. Meeting, Bal. Harbour, FL, 10-13 May 1976

DATE
ABSTRACT
Basic anthropometric dimensions provide engineers and designers with data on the range of body size variability that must be accommodated in the design and development of clothing, personal-protective equipment and workspaces. Designers of cockpits and similar workspaces must also be cognizant of the growth in body size associated with various configurations of clothing and personal-protective equipment and the effects of these assemblies on performance of the users. A study of a stratified sample of 32 USAF pilots wearing their operational assemblages of over-land and over-water flight gear and equipment was conducted. The study determined changes in critical workspace dimensions and arm and leg reach performance due to encumber-

investigation indicated changes occurred both in body size and performance which were of significance to designers.

ments of the clothing and equipment. The results of the

TITLE AIRCREW PROTECTIVE CLOTHING AND DEVICES SYSTEM (FIGHTER/ATTACK AIRCRAFT) (U), 49 P., (U)

AUTHOR S.J. Winsko and A.S. Hellman

CORP Naval Air Development Center, Crew Systems Dept. (Warminster, PA)
REPORT NADC-75294-40

AVAIL Available from NTIS as N77-20780; Available from DTIC as AD A031566
DATE 1275

A study was conducted to portray the major mission profiles in which the Fighter/Attack community is engaged and by so doing, to identify the problem areas associated with the current inventory of Fighter/Attack Aircrew Protective Equipment toward fulfilling the requirements of these missions. The ultimate objective of this effort is to provide a sound basis from which a series of separate but coordinated engineering developments will be conducted to provide a new generation of mission-oriented protective systems for the Fighter/Attack community. The

net effect of this program will be to enhance the inflight

performance and effectiveness of all Fighter/Attack aircrewmen with little or no sacrifice to their safety in the event of an emergency situation.

027 TITLE

028

REDUCTION OF ISOMETRIC MUSCLE ENDURANCE AFTER WEARING IMPERMEABLE GAS PROTECTIVE CLOTHING (U)

AUTHOR

J. Smolander, V. Louhevaara, T. Tuomi, O. Korhonen and J. Jaakkola

CORP SYMURL

Inst. Occupat. Hlth. Dept. Physiol. (Helsinki/Finland) European, Journal of Applied Physiology and Occupational Physiology, V53, N1, P.76-80

DATE

TITLE

INDIVIDUAL FACTORS IN THE CHOICE OF RESPIRATORY PROTECTIVE DEVICES

(U)

AUTHOR SYMURL W.S. Beckett and C.E. Billings

American Industrial Hygiene Association Journal, Vol. 46 No. 5,

May 1985, Pp. 274-276

DATE ABSTRACT

Safety considerations and physical and physiological factors in the choice of occupational respirats y protective devices are reviewed. In work environments where a risk of toxic inhalation exposure exists, respiratory protective devices are required when engineering controls cannot provide adequate protection. Choice of a respirator requires thorough knowledge of the requirements of the job, and a medical history and physical examination of the worker. It is pointed out that respiratory protective devices have been engineered to permit porolonged use at high workloads by healthy young males without producing adverse physiologic consequences. Since all respirators interfere with speech, hearing, vision, mobility, or some combination of these, a respirator must be chosen which does not interfere with any essential of work safety. Space limitations of the work environment should be considered. Fit testing is recommended for comfort and protection. Problems with glasses or facial hair, prior neck or face contact lenses, dentures, survery, and a variety of skin diseases are considered. Physiological factors to be considered include individual alterations of ventilation with increased work loads and added cardiovascular stress. Variability in the threshold of perception of the respiratory load and the magnitude estimation of inspiratory resistance affect worker acceptance of the protective devices. Added cardiovascular stress due to respirators which add considerable weight is also discussed. The authors conclude that careful consideration must be given to the individual worker, the work environment, the requirements of the job, and the particular characteristics of the device in choosing a respirstory protective device.

029

TITLE

BIOPSYCHOLOGICAL RESPONSES OF MEDICAL UNIT PERSONNEL WEARING CHEMICAL DEFENSE ENSEMBLE IN A SIMULATED CHEMICAL WARFARE ENVIRONMENT (U)

AUTHOR SYMURL DATE **ABSTRACT**

B.J. Carter and M. Cammermeyer Military Medicine, Vol. 150 No. 5, Pp. 239-249

0585

A study of biopsychological responses of soldiers to wearing clemical warfare defense gear was conducted. Questionnaires pertaining to biopsychological symptoms were administered to 105 personnel of an Evacuation Hospital, Oakland Army Base, California, after they participated in a training exercise wearing chemical werfare protective gear designed for Mission Operated Protective Posture, This gear represented the highest degree of protection in a chemical environment and consisted of an over garment, mask with hood, over boots, and gloves. Ninety nine questionnaires were returned. Fifty five of the respondents were females. The subjects ranged in age from 17 to 58 years. The ethnic background of the subjects included: AfroAmerican, 32.9 percent; Caucasian, 50.55 percent; Asian/American, 0.89 percent;

and Hispanic/American, 6.59 percent. Seven subjects did not wear the gear through the exercise. Of these, four terminated the exercise due to hyperventilation, claustrophobia, dizziness, headache, or inability to tolerate the mask. Three subjects terminated due to difficulty with the gear. Of those completing the exercise, 69 subjects reported at least one biopsychological response. The most frequently reported responses were rapid breathing, shortness of breath, loss of side vision, sweating, visual disturbances, anxiety, and claustrophobia. The mean number of responses reported per subject was 3.725, with females reported 3.977 mean responses and males, 3.308. About half of the subjects reported difficulty with the protective equipment. More non Caucasians than Caucasians reported have difficulty with the equipment. Ethnic background was not significantly correlated with number of responses reported. The authors suggest that the responses could be attributed to physical effort

O3O TITLE

REDUCTION OF ISOMETRIC MUSCLE ENDURANCE AFTER WEARING IMPERMEABLE GAS PROTECTIVE CLOTHING (U)

AUTHOR

J.V. Smolander, V. Louhevaara, T. Tuomi, O. Korhonen and J. Jaakkola

SYMURL DATE ABSTRACT European Journal of Applied Physiology, Vol. 53 No. 1, Pp. 76-80

Muscle endurance after wearing gas protective clothing was investigated. Six health volunthers underwent clinical stress tests, anthropometric measurements, and determinations of maximum oxygen consumption and anaerobic threshold. The subjects walked at 21 and 41 percent of maximum oxygen consumption work levels on a treadmill, wearing 25 kilograms of an impermeable gas protective suit. The isometric strength of the subjects was measured using the maximum voluntary contractions of their hand grips. During light and moderate walks in unventilated suits, oxygen consumption averaged 14.7 and 27.6 millimeters per minute per kilogram, respectively, and heart rate reach 120 and 167 beats per minute, respectively. The wearing of gas protective clothing caused significant increases in rectal and skin temperatures over comparisons doing the same work. At low work levels, the isometric muscle endurance decreased 12 percent after wearing protective clothes, and decreased by 24 percent at high work levels. The authors conclude that the wearing of impermeable gas protective clothing, even with ventilation, causes a decrease in isometric muscle endurance, probably by an effect of the increased temperature of the contracting muscles.

O31 TITLE
AUTHOR
SYMURL
DATE
ABSTRACT

PHYSICAL EXERCISE AND INDUSTRIAL RESPIRATORS (U) M. van Putten, F. Verstappen and L. Bloemen International Journal of Sports Medicine, Vol. 5, Pp. 13-14 1184

The effects of industrial inspiratory pressure respirators on breathing and circulation during exercise were compared with those on negative inspiratory pressure respirators. Fire fighters experienced in respirator use and athletes without experience with respirators used either system or no respirator while using a bicycle ergometer at up to 80 percent of maximum oxygen intake until exhaustion or while walking on a treadmill with protective clothing and respirator equipment. The highest work load achieved, heart rate, respiration rate, 1 minute ventilation, oxygen uptake, and blood lactate concentrations were determined for each trial. No effect of either respirator seen on work load achieved, heart rate, or maximum blood lactate concentrations. No effect of respirators were seen during submaximal effort. There was a difference in working capacity, expressed as oxygen uptake, between the trained athletes and the fire fighters but this was not affected by either respirator type. In most cases there was no effect of the type of exercise. Although for some subjects the physiological results of the two exercises were quite different, no effect of the respirators was

seen. The authors conclude that neither respirator type has significant effect on body function during exercise. Experience in using the respirators appears not to be a factor in performance. Specificity of the work performed can affect the results and should be considered.

O32 TITLE AUTHOR SYMURE

AUTHOR SYMURL DATE ABSTRACT PSYCHOLOGICAL REACTIONS DURING CHEMICAL WARFARE TRAINING (J) F.R. Brooks, D.G. Ebner, S.N. Xenakis and P.M. Balson Military Medicine, Vol. 148 No. 3, Pp. 232-235 0383

Psychiatric symptons occurring during a combat field exercise for chemical warfare training were studied. In simulations designed to test medic triage and emergency treatment of casualties in a chemical environment, mock casualties and trained combat medics wore chemical protective gear. Smoke was generated to simulate gas attack. The protective gear included mask, coat, trousers, gloves, and boot covers. Psychological symptoms and behavioral problems were recorded in participants by a project officer assigned to monitor each group. Psychological symptoms were detected immediately after the start of the exercise and throughout its course. Three of the 70 participants experienced symptons sufficiently debilitating to cause them to end participation. They reported panic immediately and showed hyperventilation, confusion and visual distortion. Three other participants experienced early symptoms but were able to continue with reassurance. Eight other subjects experienced difficulties in the later portions of the test, with poor judgement in problem solving and dyspnea, visual blurring, confusion and fear. The authors conclude that in this situation there was at least a 20 percent incidence of psychological reactions with gross symptoms. Very few of the soldiers had worn the protective gear before and none had worn it while performing combat tasks in a chemical environment. They recommend development of prevention strategies such as simulation, modeling, self management and inoculation training. Soldiers should practice as a soldier and as a casualty. Secondary prevention strategies should include training to reassure self or companions, with the medic considered a resource for the affected soldier.

O33 TITLE

AUTHOR SYMJRL DATE ABSTRACT IMPACT OF THE CHEMICAL PROTECTIVE ENSEMBLE ON THE PERFORMANCE OF BASIC MEDICAL TASKS (U)
J.M. King and A.J. Frelin

Military Medicine, Vol. 149 No. 9, Pp. 496-501

0984

The ability of military medical specialists to perform field tasks while subjects wore fatigues, Mission Oriented Protective Posture (MOPP) gear, or MOPP gear with a prototype glove designed to improve tactile sensitivity was investigated. Eight tasks requring dexterity and coordination were chosen. They were: administration of emergency care to a chemical agent casualty or first aid to a patient with a sucking chest wound; initiation of field card or intravenous infusion; application of a splint to a fractured lower extremity or application of a tourniquet; immobilization of a fracture; and application of field first aid dressing. Performance decreased with MOPP gear and MOPP gear plus gloves, which required 53 and 29 percent more time, respectively, than did performance in fatigues. Performance improved with time. The gloves had low durability; 15 ot 18 gloves had flaws by the end of the 6 days. Improvement in cuff design was suggested. Subjects reported that they did not feel comfortable wearing the gloves in a contaminated environment. The authors suggest that the number of personnel be increased in situations where MOPP gear and MOPP gear with tactile gloves are used. However, tasks can be performed while wearing MOPP if troops are trained.

INFLUENCE OF WEIGHT OF PERSONAL PROTECTIVE EQUIPMENT ON THE FUNCTIONAL STATUS OF THE BODY DURING PHYSICAL WORK IN VARIOUS 034 TITLE MICROCLIMATIC CONDITIONS (U) AUTHOR G.V. Barvo and I.F. Saskov CIS 77-497 \$ FTD-ID(RS)T-1181-79 REPORT LANG Pussian AVAIL Available from DTIC as AD BO46412L SYMURL Gigiena i Sanitariya, No. 9, Pp. 60-62 DATE 0975 ABSTRACT Results of research carried out in volunteers wearing protective clothing weighing 1 to 11 kilograms in various climatic conditions (12, 23 and 45 degrees centigrade, relative air humidity 75%). On the basis of the results, relating to energy 20 to expenditures, sweat loss, pulmonary ventilation and neart rate recorded during the experiments, the authors recommended the following criteria for weight of personal protective clothing: under 7 kilograms for work of average laboriousness in conditions enabling thermal balance to be maintained; under 3 kilograms in conditions giving rise to heat stasis; up to 11 up to 11 kilograms in conditions where heat removal is facilitated. (Russian) 035 TITLE COMPARATIVE TEST CHEMICAL/BIOLOGICAL (CB) DISPOSABLE OVERGARMENT (U), 54 P., (U) **AUTHOR** W. Foss CORP Tactical Air Command, USAF Tactical Air Warfare Center (Eglin AFB, FL) AVAIL Available from DTIC as AD 916363 DATE 0174 ABSTRACT Four design models of chemical/biological protective disposable overgarments were tested for use by the Air Force. Tasks for the use of the protective garments included disaster situations, the disposal of dangerous explosives, and the overseeing of munitions loading. It as hoped that air and flight line maintenance crews would be able to perform their tasks wearing each of the four undergarments. Due to the generation of high amounts of static electricity in the nylon designs of the first and second suits, testing was limited to the analysis of the third and fourth designs. The first two garments were considered inadequate due to hazards in the design of the garments, especially the material's dange of puncturing when it was donned. The hood of the first garment tended to pull away from the inlet valves on the gas mask. The M6A2 hood unit for use with the second suit was not able to sufficiently cover the neck's opening to forestall leaks. The third and fourth garments also experienced leaks with the M6A2 hood, and none of the crews were able to successfully complete all of their tasks. Companison of the test crew's performance indicated that design three was more comforto wear, but its trouser cuff drawstrings and blouse waistband gave less protection since they let air into the suit. In one instance, a solvent was able to penetrate the fabric causing skin irritation. Of the two, the fourth design was deemed to be more appropriate. As a result of the problems in design, it was recommended that none of the four desings be used as a work suit. Sample evaluation forms and photographic illustrations are included. 036 TITLE TACTICAL IMPLICATIONS OF THE PHYSIOLOGICAL STRESS IMPOSED BY CHEMICAL PROTECTIVE CLOTHING SYSTEMS (U) AUTHOR R.F. Goldman 1970 Army Science Conference held at West Point, NY, June 1970, SYMURL Pp. 1-15 DATE 0670 **ABSTRACT** Heat stress in soldiers wearing chemical protective uniforms was studied. Physical heat transfer of uniform materials was measured by flat plate techniques, protective ensembles were

evaluated on a sweating copper manikin, and predictions were validated in climatic chamber trails with volunteers marching on treadmills. Clothing systems were tested in the field in small scale studies and during field maneuvers. Results of field trails supported laboratory predictions. The tolerance limit for soldiers wearing encapsulating clothing and doing heavy work at temperatures above 75 degrees F was about 30 minutes. Men carrying heavy loads covering more ground, or in poorer physical condition were the most likely to be heat casualties. The author concludes that chemical protective uniforms severely reduce the performance of soldiers, even in temperature environments. Recommendations are given for reducing or controlling heat stress among soldiers.

TITLE 037

HEAT LOAD AND WORK CAPACITY DURING USE OF PERSONAL PROTECTIVE EQUIPMENT (U)

AUTHOR REPORT S.P. Rajhman and V.V. Bubnev

LANG

CIS 77-996 Russian

SYMURL DATE

Gigiena i Sanitarija, No. 3, Pp. 41-45

0376

ABSTRACT

Results of studies in volunteers performing a moderately strenous task while wearing either cotton clothing, impermeable protective clothing, or filter respirators. Heat load was assessed from the rectal and skin temperature, heart rate, work capacity, dynamic and static endurance, coordination of movements, and muscular bioelectrical activity. There was a quantitative relation between metabolic heat accumulated in the body and the physical work capacity. Changes in the latter appeared to be a major criterion for establishing work standards under the conditions studies. (Russian)

038

TITLE AUTHOR SYMIRE DATE **ABSTRACT** COMPARISON OF REACTIONS TO INDUSTRIAL PROTECTIVE CLOTHING (U)

N.T. Thomas, J. Spencer and B.T. Davies Annals of Occupational Hygiene, Vol. 19 No. 3/4, Pp. 259-268

1276

An attempt is made to assess the effects of wearing protective clothing in warm environments. The aim to provide data from which recovery times could be assessed. Normal clothing and five protective assemblies, four of which covered head and body, were tested on separate days for five cycles, each of 20 minute work and 5 minute rest. For all protective assemblies increasing heat strain followed similar patterns when measured by heart rate. body temperature and subjective assessment. With normal clothing the work/ rest schedule was adequate, but it was unsatisfactory with the protective assemblies, when times required for specified tasks also increased. Simple heart rate measurements were found to be more reliable for assessing rest requirements than any of the existing recommended Relaxation Allowances. For applications when the head must be covered, the compressed-air suit was shown to have physiological and psychological advantages over the three simpler assemblies tested.

039

TITLE AUTHOR LANG SYMURL DATE **ABSTRACT** PSYCHOPHYSIOLOGICAL PROBLEMS PRESENTED BY SAFETY GLASSES (U)

M. Krawsky

French

Cahiers de Notes Documentaires, No. 58, 2nd Trimester, Pp. 185-193 0069

Psychophysiological problems presented by safety glasses reviewed. Topics include problems attributed to eye protection gear by users; acceptance criteria of protective gear as a function of the task; optical qualities of protective eye gear; examination of new and used glasses; and topography of the deteriorations. More durable transparency of the glasses enhances the visibility at the work site and influences the users' safety and job performance.

INTERNATIONAL CONFERENCE ON BIOPHYSICS AND PHYSIOLOGICAL EVALUATION OF PROTECTIVE CLOTHING (U), 16 P., (U) (Conference TITLE 040 proceeding) **AUTHOR** U. Danielsson CORP Foersvarets Forskningsanstalt (Stockholm, Sweden) REPORT F0A-C-54054-H1 ORIGIN Sweden LANG Swedish AVAIL Available from NTIS as PB84-176346 DATE 0384 **ABSTRACT** The Conference was held in July 4-8 in Lyon, France. subject of the conference was the impact of, and protection against conventional -as well as non-conventional weapons. The effect of wearing protective clothings and working capacity was discussed and to some extent the problem of trading risk of CB-or fragment casualties for decreased combat efficiency. The development of personal protective clothing was discussed at the same time as a need of new test methods was expressed. Methods for evaluation of protective clothings with respect to combat within the comfort-zone, as well as the physiological strain beyond it. TITLE C-SKYDD OCH EFFEKTIVITET I FAELT (CW-PROTECTION AND COMBAT 041 EFFICIENCY) (U), 28 P., (U) AUTHOR U. Danielsson REPORT FDA-C-54049-H1 ORIGIN Sweden LANG Swedish AVAIL Available from NTIS as PB83-241091 DATE 0083 **ABSTRACT** This literature study deals with the effects on various military activities when wearing individual protection against chemical warfare (CW) A complete chemical warfare protective gear, i.e., mask, overgarment, gloves, and boots, reduces the combat efficiency. The reason is (1) Heat stress, which will be pronounced in particular if the combat uniform is used beneath the CW-protective gear. In order to prevent heat exhaustion, the time for accomplishing a heavy task must increase 2-6 times compared with the expected time when wearing only the normal combat uniform. The CW-protective overgarment alone will cause a heat stress, which is comparable with that of the ordinary combat uniform. (2) Reduced manual dexterity and mobility due to wearing gloves and boots. (3) Restricted communications (vision and hearing) due to mask design. (4) Reduced work capacity due to the air resistance of the protective mask, dehydration, and reduced energy supply. 042 TITLE EVALUATION OF CHEMICAL PROTECTIVE FACELETS AND COMPARISON OF FOUR PROTOTYPES (U), 21 P., (U) AUTHOR W.A. Lotens CORP Institute for Perception RVO-TNO, Soesterberg (Netherlands) REPORT IZF-1980-15 \$ TDCK-75013 ORIGIN Nether lands LANG Dutch, English Summary AVAIL Available from NTIS as N82-15784 DATE 0080 **ABSTRACT** In a controlled field experiment four prototypes of chemical protective facelets were tested to determine the effect on physical and mental performance, and the chemical protection and ergonomic properties. Wearing facelets decreases the physical performance on running 400 m resp. 3 km by 3.5 resp. 7.5 percent. When worn during 24 hr. physical performance is variable and mental performance decreases by ca. 10 percent. There is no indication for adaptation within a one-week period. Chemical protection is sufficient for all four types after a while of wearing, however, one of four is highly sensitive for

rain. Ergonomic tests show only slight differencies between the facelets but there is a marked difference in comfort. Because of this the subjects preferred two types above the other two. Protection during sleep is far from optimal.

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043	TITLE	PROJECT FIRES; VOL. 4, PROTCTYPE PROTECTIVE ENSEMBLE QUALIFICATION TEST REPORT, PHASE 1B (U), 127 P., (U) F.J. Abeles
	CORP REPORT	Grumman Aerospace Corp., Advanced Development Dept. (Bethpage, NY) NASA-CR-161532
	AVAIL DATE	Available from NTIS as N80-32099 0580
	ABSTRACT	The qualification testing of a prototype firefighter's protective ensemble is documented. Included are descriptions of the design requirements, the testing methods, and the test apparatus. The tests include measurements of individual subsystem characteristics in areas relating to both physical testing, such as heat, flame, impact penetration and human factors testing, such as dexterity, grip, and mcbility. Also, measurements related to both physical and human factors testing of the complete ensemble, such as water protection, metabolic expenditures, and compatibility are considered.
044	TITLE	DEXTERITY AFFORDED BY CW PROTECTIVE GLOVES (U), 33 P., (U)
	AUTHOR	P.V. Vittorio and S.W. Cattroll
	CORP REPORT ORIGIN	Defense Research Establisment Ottawa (Ontario) DRED-TN-75-21 Canada
	AVAIL DATE	Available from DTIC as AD A017654 1075
	ABSTRACT	The effects on manual performance of an experimental canadian CW protective glove and US and UK CW protective gloves were compared using five different manual tasks. The results show that, statistically, performance in three of the manual dexterity tasks was significantly better with the US CW protective glove than with the Canadian or the UK CW protective gloves and in the same three tasks there was not significant difference in performance between the latter two gloves. Although the difference shown is statistically significant, its practical effect in the performance of military tasks may not be great.
045	TITLE	INFLUENCE OF PROTECTIVE CLOTHING ON HUMAN STRESS IN WORK UNDER EXPOSURE TO THERMAL RADIATION (U)
	AUTHOR Symurl	R. Hertting and T. Hettinger Arbeitsmedizin sozialmedizin Praeventivmedizin, 1984, Vol. 19 No. 1, Pp. 9-14
	DATE	0084
	ABSTRACT	Four different types of working clothes: a normal working guit, a melter's suit and 2 different aluminised heat protective suits were tested to measure the effects upon humans working in normal room temperatures and in a room with heat radiation of 750 watts per square meter. Results show that in normal room temperatures the effect depend on the weight of the suits while in hot conditions the heat protective suits were most effective.
046	TITLE	INNOVATIVE TEST OF PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF NBC AND EXTENDED OPERATIONS ON MECHANIZED INFANTRY SQUADS (SHORT TITLE: INFANTRY P2NBC2) (U), 148 P., (U)
	AUTHOR CORP AVAIL DATE	K.J. Posen, G.W. Mitchell, I. Munro and J.W. Satterthwaite Army Infantry Board (Ft. Benning, GA) Available from DTIC as AD B101365L 0486
047	TITLE	COMPARATIVE VISUAL PERFORMANCE WITH ANVIS (AVIATOR'S NIGHT VISION IMAGING SYSTEM) AND AN/PVS-SA NIGHT VISION GOGGLES UNDER STARLIGHT CONDITIONS (U), 23 P., (U)

AUTHOR II Miller R.E., W.F. Provines, M.G. Block, J.W. Miller and T. Tredici CORP AF School of Aerospace Medicine (Brooks AFB, TX) REPORT USAFSAM-TR-84-28 Available from DTIC as AD B086902L AVAIL DATE ORRA 048 TITLE FACTORS LIMITING ENDURANCE OF ARMOR, ARTILLERY, AND INFANTRY UNITS UNDER SIMULATED NRC CONDITIONS (U), 15 P., (U) **AUTHOR** . Munro, T.M. Rauch, W.J. Tharion, L.E. Banderet and A.R. Lussier CORP Army Research Institute of Environmental Medicine (Natick, MA) REPORT USARIEM-M-18/86 AVAIL Available from DTIC as AD A165865 DATE 0386 **ABSTRACT** The war of the future will require 72-hour operations in environments contaminated with nuclear/biological/chemical (NBC) agents. The 1985 P2NBC2 (physiological and psychological effects of NBC and extended operations on combined ars crews) program assessed solider endurance and performance under simulated NBC conditions. A total of 175 soldiers were observed during four tests differing in design, site, climatic conditions, and performance demands. In all but one of the iterations where the full chemical protective ensamble (MOPP 4) was used without cooling, soldier endurance fell far short of the projected requirement. Psychological data were analyzed to determine which factors were associated with the incidence of casualties. The findings showed that perceived intensity of symptoms resembling the hyperventilation syndrome was significantly greater in soldiers classified as casualties. Five of these symptoms (painful breathing, difficulty breathing, shortness of breath, headache, and nausea) showed casualty-survivor differences in all tests. Symptom intensity was attributed to two factors. (1) External conditions. Thermal stress exacerbated the five basic symptoms, induced others (tetany and paresthesia), and decreased endurance. Periodic relief from respirator use attenuated these symptoms and enhanced endurance. (2) Individual differences. Significant casualty-survivor differences in anxiety, depression, and cognitive strategy scores indicated that perception of hyperventilation symptoms and endurance were related to personality variables. Hyperventilation symptoms could incapacitate the soldier or induce removal of the protective mask under actual chemical attack. TITLE 049 EFFECTS OF FATIGUE FROM WEARING THE AN/PVS-5 NIGHT VISION GOGGLES ON SKILLS INVOLVED IN HELICOPTER OPERATIONS (U), 49 P., (U) AUTHOR G.D. Chastain and A.L. Kubala CORP Human Resources Research Organization (Alexandria, VA) HUMRRO-FR-WD-TX-78-18 \$ ARI-RR-1217 REPORT AVAIL Available from DTIC as AD A075426 DATE 0779 **ABSTRACT** Reviews of the literature on rotary wing flight and interviews with aviators were conducted to determine which helicopter tasks and maneuvers are performed most frequently and/or are the most critical. Those operations found to be most critical were analyzed into perceptual and psychomotor components, and a battery of perceptual and psychomotor tests was selected to measure these factors. Aviators were tested both before and measure these factors. Aviators were tested both before and after flying with the AN/PVS-5 goggles. Eye-hand coordination was marginally affected following flight, and reaction time to lights was significantly affected. EFFECT OF FLIGHT GLOVES AND METHOD OF DATA ENTRY ON SPEED AND TITLE 050 ACCURACY OF POSITIONING THUMBWHELL SWITCHES (U), 19 P., (U) D.W. Plath and P.E. Kolesnik AUTHOR

Autonetics (Downey, CA)

CORP

	REPORT AVAIL Date	T5-900/3111 \$ IDEP 347.90.00.00-C1-02 Available from DTIC as AD 468881 0565
	ABSTRACT	The purpose of this study was to evaluate the speed and accuracy with which latitude and longitude coordinate information can be entered into a computer by use of a thumbwheel switch unit. More specifically, it was to determine the effect of flight gloves on thumbwheel operation, and to compare two methods of using thumbwheels for entering coordinates. In the first method, one thumbwheel unit was used to enter both latitude and longitude of a given checkprint before proceeding to all the coordinates of the next checkpoint. In the second method, all latitude coordinates were entered sequentially, after which all longitude coordinates were entered in a similar manner. This method simulated the use of two thumbwheel units -one for latitude and one for longitude.
051	TITLE	EFFECT ON MOTOR PERFORMANCE OF ACUTE VENOUS IMPEDIMENT AND MUSCULAR TENSION (U)
	AUTHOR CORP	T.D. Hanna Naval Air Engineering Center, Aerospace Crew Equipment Lab. (Philadelphia, PA)
	REPORT	451
	AVAIL Date	Available from DTIC as AD 253927
	ABSTRACT	Because of the fatigue and decreased efficiency resulting from wearing various aviation protective gear on prolonged flights, the following study was conducted. Two measures of stress (1) static muscular tension, and (2) brachial venous impediment were used to evaluate various aspects of motor performance. Two degrees of each of these two stress conditions were employed. The results show that manual dexterity is deleteriously affected by all stress conditions, while fine weight discrimination and rapidity of sustained finger movement were not so affected. A significant increase in heart rate was observed to accompany
052	TITLE	every stress condition. MAINTENANCE OPERATIONS IN A CHEMICALLY CONTAMINED ENVIRONMENTS
	AUTHOR	(U), 88 P., (S) D.L. Welch
	CORP	Andrulis Research Corp. (Bethesda, MD)
	REPORT	DPG-5-82-502
	AVAIL DATE	Available from DTIC as AD C031036L 0283
053	TITLE	EFFECTS OF CHEMICAL ATTACK ON TACTICAL STAGING OPERATIONS (U), 236
	AUTHOR CORP	K.S.K. Chinn Army Dugway Proving Ground (UT)
	REPORT	DPG-S-81-501
	AVAIL DATE	Available from DTIC as AD CO29783L O681
054	TITLE	USACDEC OBSERVATIONS AND MILITARY JUDGMENTS (U), 9 P., (S)
	CORP	Army Combat Developments Experimentation Command (Ft. Ord, CA)
	DATE	Available from DTIC as AD COOG105L 0376
055	TITLE	COMBAT EFFICIENCY -THE EFFECT OF INDIVIDUAL NBC PROTECTION ON PERFORMANCE (U), 57 P., (C)
	AUTHOR	P.L. Evans and R.R. Hunt
	CORP REPORT	Chemical Defense Establishment Porton Down (England) CDE-FTR-39 \$ DRIC-5R-50834
	AVAIL	Available from DTIC as AD C951874L
	DATE	0675

056	TITLE	EFFECT OF INDIVIDUAL NBC PROTECTION ON THE PERFORMANCE OF INFANTRY (U), 75 P., (C)
	AUTHOR	R.R. Hunt and P.L. Evans
	CORP	Chemical Defense Establishment Porton Down (England)
	REPORT	CDE-FTR-46
	AVAIL	Available from DTIC as AD C950129L
	DATE	0574
057	TITLE	SUBJECTIVE REPORTS ON THE EFFECTS OF NBC PROTECTIVE CLOTHING ON MILITARY DUTIES AND EVERYDAY ACTIVITIES PRELIMINARY REPORT (U), 75 P., (U)
	AUTHOR	L.E. Magee
	CORP	Defense and Civil Inst of Environmental Medicine Downsview (Ontario)
	REPORT	DCIEM-84-R-32
	AVAIL	Available from DTIC as AD CO36156
	DATE	0884
	DATE	V604
Ot: B	TITLE	REPORT ON TRIAL NUMBER DCGE/DRED 2/71; PT. 1, THE EFFECTS OF CANADIAN CW PROTECTIVE CLOTHING ON THE PERFORMANCE OF INFANTRY ACTIVITIES (U), 75 P., (C)
	AUTHOR	J.O. Sturk
	CORP	Defense Research Establishment Ottawa (Ontario)
	REPORT	DRED-684
	AVAIL	Available from DTIC as AD 527514L
	DATE	0873
	ABSTRACT	Canadian CW Protective Coveralls were worn by one hundred men for three full weeks in a troop test in August 1971. The effects of wearing the CW ensemble on the performance of certain measurable infantry activities, compared with performance when wearing normal combat clothing, were evaluated according to the NATO Triptique for Permeable Protective Clothing. In those cases where the degradation in performance caused by the CW Coveralls was statistically significant, it was still within the limits specified by the Triptique. Samples of Coveralls worn for one, two and three weeks were obtained for subsequent determination of residual chemical protection. Informatin on CW Overshoes and Gloves, as well as the Coverall, was obtained.
059	TITLE	MISSION DEGRADATION RESULTING FROM CHEMICAL PROTECTIVE POSTURES (U), 99 P., (C)
	AUTHOR	K.A. Krieger, A.F. Haney and P.R. Cleveland
	CORP	Pennsylvania U. (Philadelphia, PA)
	AVAIL DATE	Available from DTIC as AD 381959L
	DATE	0467
060	TITLE	COMBINED EFFECTS OF SLEEP LOSS AND NBC CLOTHING UPON SOME ASPECTS OF MILITARY PERFORMANCE (U), 56 P., (FOREIGN RESTRICTED)
	AUTHOR	D.R. Haslam
	CORP	Army Personnel Research Establishment Farnborough (England)
	REPORT	DRIC-BR-81854
	AVAIL	Available from DTIC as AD C951317L
	DATE	1081
061	TITLE	DEXTERITY AFFORDED BY CANADIAN GLOVES (U), 39 P., (FOREIGN RESTRICTED)
	AUTHOR	P.V. Vittorio, D.J.G. Soper and S.W. Cattroll
	CORP	Defense Research Establishment Ottawa (Ontario)
	REPORT	DREO-TN-75-4
	AVAIL	Available from DTIC as AD COO3273L
	DATE	0475
	ABSTRACT	The effect on manual performance on the Canadian G.P. glove and the Canadian CW protective glove, worn with and without woolliner, were compared using five different manual tasks.

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062	TITLE	COST OF PRODUCTION SENSITIVITY TESTS (U), 29 P., (FOREIGN RESTRICTED)
	AUTHOR	A.M. Reid
	CORP	Army Personnel Research Establishment by Fleet (England)
	REPORT	APRE-4M-P/1, STUDY-R.12 \$ STUDY-R.12
	ORIGIN	England England
	AVAIL	Available from DTIC as AD 398456
	DATE	0167
	ABSTRACT	This study seeks a means of assessing the effects, or influence, on his total performance of what the solider wears and carries. Sensitivity tests of particular military performance tasks were carried out in November/December 1965, the purpose of the tests was to find out how discriminating the perforance tasks were: specifically, how sensitive each task was to changes in load on the man, in terms of individual performance. Comparative measures were taken on the same men carrying each of the specified loads in a designed experiment involving all of the tasks. The five tasks used were: Marching, Agility, Digging, Shooting, and Fieldcraft. These tasks were ranked in importance to infantry in the top 10 tasks of a comparable study current in the US.
063	TITLE	COST OF PROTECTION, PT. 1 (U), 41 P., (FOREIGN RESTRICTED)
	AUTHOR CORP	A.M. Reid Army Personnel Research Establishment Farnborough (England)
	REPORT	APRE-R-11/72
	ORIGIN AVAIL	England Available from DTIC as AD 596824
	DATE	CO72
	ABSTRACT	The aim of the study is to develop a means of assessing individual military performance which can be used to establish the extent of the cost of protection, in terms of bodily strain and reduced performance.
064	TITLE AUTHOR	COST OF PROTECTION, PT. 2 (U), 42 P., (FOREIGN RESTRICTED)
	CORP	Army Personnel Research Establishment Farnborough (England) APRE-R-16/73
	ORIGIN	England
	AVAIL DATE	Available from DTIC as AD 596825
	ABSTRACT	The aims of the trials described in Part 2 of the Study were: (1) to determine any decrements in Military Performance when wearing particular protective assemblies and equipments, as compared with normal issue combat clothing assembly and equipment as used in conventional warfare; and (2) to assess the consequent impact on the combat effectiveness of the soldier.
065	TITLE	ASSESSMENT OF THE EFFECTS OF WEARING FULL NBC PROTECTIVE CLOTHING AND EQUIPMENT ON THE MILITARY PERFORMANCE OF ALL ARMS; VOL. 1
	CORP	(U), 37 P., (FOREIGN RESTRICTED)
	REPORT	Army Personnel Research Establishment Farnborough (England)
		APRE-1/73-V1
	ORIGIN	England
	AVAIL	Available from DTIC as AD 596480
	DATE	0473
	ABSTRACT	A tactical exercise was designed so that an assessment could be made of the effects of wearing full NBC protective clothing and equipment on the military performance.
066	TITLE	GROUNDCREWS TEST CHEMICAL WARFARE ENSEMBLE WITH AND WITHOUT LIQUIDCONDITIONED GARMENTS (U), 21 P., (U)
	AUTHOR	J.C. Miller, D.C. Boone, S.M. Rokicki, K.G. Cornum and M. Davis
	CORP	School of Aerospace Medicine (Brooks AFB, TX)
	REPORT	USAFSAM-TR-85-24

	AVAIL DATE ABSTRACT	Available from DTIC as AD B096285 O685 The F-4C combat turns were performed by three munitions and two maintenance personnel, wearing the near-term ground-crew Chemical Warfare Defense Ensemble (CWDE), with and without liquid-conditioned garments (LCG), in a moderate environmentone which imposed no external heat stress. The turns involved aircraft inspections, refueling, drag-chute replacement, and the upload of four AIM-7 (Sparrow) missiles. Ambient temperatures were about 24 C dry bulb, 22.5 C wet bulb, and 25 C black globe. Task performance times in the CWDE were not affected by LCG, and were within combat time limits. Subjective ratings of fatigue and stress hormone (norepinephrine) excretion rate were reliably reduced by LCG wear. Questionnaire ratings and responses, and the subjects' remarks, showed that the LCG concept was welcomed on the flight line. Theese tests were designed to assess certain aspects of garment wearability, and not to test thermal effects.
067	TITLE CORP REPORT AVAIL DATE ABSTRACT	AVIATION PERFORMANCE ASSESSMENT IN A CHEMICAL ENVIRONMENT (APACHE); VOL. 1, TEST REPORT (U), 700 P., (U) Army Combat Developments Experimentation Command (Ft. Ord, CA) CDEC-TR Available from DTIC as AD 8073007L 0383 This report presents the findings of the APACHE Test and documents the methodology and approach used during the conduct of the test. The objectiva and subjective data from the APACHE Test will be used by the Army Aviation Center, Army Chemical School and Army Materiel Systems Analysis Agency to support assessment of aviation chemical operations, assist in development of doctrine, and in making force development recommendations. A general trial scenario is listed and data summaries presented.
068	TITLE CORP REPORT AVAIL DATE	AVIATION PERFORMANCE ASSESSMENT IN A CHEMIC'L ENVIRONMENT (APACHE); VOL. 2, TEST REPORT (U), 700 P., (U) Army Combat Developments Experimentation Command (Ft. Ord, CA) CDEC-TR Available from DTIC as AD 8072964L O383
069	AUTHOR CORP REPORT AVAIL DATE	EVALUATION OF COMBAT VEHICLE GUNNER PERFORMANCE WITH VARIOUS COMBINATIONS OF NBC (NUCLEAR, BIOLOGICAL, CHEMICAL) PROTECTIVE APPAREL: A LABORATORY STUDY (U), 73 P., (U) R.A. Lee, M. Glumm and M. Singapore Army Tank-Automotive Command (Warren, MI) RACOM-TR-12714 Available from DTIC as AD 8072814L 0383
070	TITLE AUTHOR CORP AVAIL DATE	FOLLOW-ON OPERATIONAL TEST AND EVALUATION (FOTSE) CHEMICAL WARFARE DEFENSE EQUIPMENT (CWDE) (U), 103 P., (U) D.L. Whitley, B.K. Hinton and G.W. Noga Air Force Airlift Center (Pope AFB, NC) Available from DTIC as AD B072065L 0283
071	TITLE CORP AVAIL DATE	AYIATION PERFORMANCE ASSESSMENT IN A CHEMICAL ENVIRONMENT (APACHE) (U), 184 P., (U) Army Combat Developments Experimentation Command (Ft. Ord, CA) Available from DTIC as AD 8068081L 0782
072	TITLE	DEFENCE TRIAL 6/425: PERFORMANCE OF INFANTRY SOLDIERS WEARING NBC CLOTHING IN HOT/HUMID AND HOT/DRY CLIMATES (U), 49 P., (U)

		FULL CITATIONS
	AUTHOR CORP REPORT AVAIL DATE	R.I. Tilley, H.D. Crone, B. Leake, R.I. Reed and V. Tantaro Materials Research Labs. (Ascot Vale, Australia) MRL-R-826 Available from DTIC as AD B065772L 0781
073	TITLE AUTHOR CORP REPORT	PRELIMINARY ASSESSMENT OF THE EFFECTS OF CB PROTECTIVE ENSEMBLES MOPP IV POSTURE ON THE PERFORMANCE OF SEDENTARY AND MODERATELY ACTIVE SOLDIERS IN A TROPICAL ENVIRONMENT (U), 53 P., (U) W.E. Hanlon, R.D. Jones and R.P. Merkey Human Engineering Lab. (Aberdeen Proving Ground, MD) HEL-TN-5-82
	AVAIL DATE	Available from DTIC as AD BO65600L 0582
074	TITLE	GROUND CREW CHEMICAL DEFENSE EQUIPMENT PERFORMANCE (TASK-TIME DEGRADATION TEST) (U), 65 P., (U)
	AUTHOR CORP REPORT AVAIL	T.J. Cox, A.R. Jeffers and T.J. Mascarella Aernautical Systems Div. (Wright-Patterson AFB, OH) ASD-TR-81-5003 Available from DTIC as AD B057406
	DATE	0581
	ABSTRACT	This report documents the results of a relatively short but intensive effort to: determine how much longer it takes ground crew personnel to accomplish combat quick turnaround tasks (F-4E aircraft) as a result of wearing their chemical warfare protective ensembles; identify potential equipment improvements; and identify possible procedure changes.
075	TITLE	MATHEMATICAL MODELING OF PERSONNEL DEGRADATION; VOL. 1, BACKGROUND INFORMATION AND THEORY (U), 76 P., (U)
	AUTHOR CORP REPORT	U.D. Claibonne AMAF Industries, Inc. (Columbia, MD) ARCSL-CR-79071
	AVAIL DATE	Available from DTIC as AD BO43547L 1279
076	TITLE	MATHEMATICAL MODELING OF PERSONNEL DEGRADATION; VOL. 2, PROGRAM DESCRIPTION FOR PDGRAM (PERSONNEL DEGRADATION MODEL) (U), 102 P., (U)
	AUTHOR	J.D. Claiborne
	CORP REPORT	AMAF Industries, Inc. (Columbia, MD) ARCSL-CR-79072
	AVAIL	Available from DTIC as AD 8043548L
	DATE	1279
077	TITLE	SEARCH FOR AN OPTIMUM FORWARD OBSERVER (FO) MESSAGE-ENTRY DEVICE (U), 58 P., (U)
	AUTHOR CORP REPORT	C.R. Hughes and A.H. Keiser Human Engineering Lab. (Aberdeen Proving Ground, MD) HEL-TM-19-77
	AVAIL	Available from DTIC as AD B020476
	DATE	0577
	ABSTRACT	A human factors test was conducted during development testing of the engineering development version of the Magnavox digital message device (DMD). The measurements obtained were used to evaluate software improvements (such as default values) on the DMD and were compared with measurements obtained for previous forward observer devices such as the fixed-format message-entry device (FFMED). Operator performance was measured under lighted, dark, gloved and gas-masked conditions. The measures were obtained under conditions approaching worst case due to the relative frequency of the formats used and other test conditions. Results indicated that operators could compose and transmit messages on the DMD in less than 60 seconds if 2 hours of hands-on training was provided. With one exception (i.e., dark-gloved condition), operation of the DMD under any condition
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was not significantly different from the lighted barehanded condition. Officers and enlisted personnel performed equally well. In addition, operators were able to enter data much faster and with fewer errors than operators tested on the FFMED. The results indicated that the dynamic default values considerably reduced data-entry time.

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078 TITLE ASSESSMENT OF ATMOSPHERIC DIVING SUITS -FIELD 178.3 RESEARCH REPO.T 1973/74 (U), 62 P., (U)

AUTHOR

I.D. Thomas and R.L. Varlow

CORP

Admiralty Underwater Weapons Establishment Portland (England) AUWE-TN-512/74 \$ DRIC BR 43830

REPORT ORIGIN AVAIL

England Available from DTIC as BOO1159L

DATE 0674

ABSTRACT

This report presents an MOD assessment of an Atmospheric Diving Suit manufactured by a UK firm called DHB Construction Ltd. A series of practical trials were arranged to evaluate the underwater working potential of the diving suit, culminating in a series of manned 1000 ft (305 m) pressure chamber dives at AUWE, Portland. The results of these trials are presented and possible areas of application for this equipment are discussed.

079

TITLE

EFFECT OF HEAT AND CHEMICAL PROTECTIVE CLOTHING ON COGNITIVE

PERFORMANCE (U), 27 P., (U) B.J. Fine and J.L. Kobrick

AUTHOR CORP REPORT

Research Inst of Environmental Medicine (Natick, MA)

AVAIL Available from DTIC as AD A162001 DATE 1185

ABSTRACT

This study examined the effects of heat on the sustained cognitive performance of sedentary soldiers clad in chemical protective clothing. Twenty males trained for 2 weeks on selected military tasks. Then they performed the tasks for 7-hour periods on 4 successive days in hot (32.80., 61%rh) and normal (32.10.35%rh) conditions, with and without protective clothing. After 4-5 hours in the heat wearing protective clothing, the cognitive performance of the group began to deteriorate markedly. By the end of 7 hrs. of heat, increases in % group error on investigat-or-paced tasks ranged from 17% to 235 over control conditions. Virtually all of the decrements were due to increases in errors of omission. The productivity of the group on a self-paced task (map plotting) diminished by approximately 40% from control conditions after 6 hrs. in the heat in protective clothing; accuracy of plotting was not markedly affected.

080

TITLE

DEGRADATION ANALYSIS METHODOLOGY FOR MAINTENANCE TASKS (U), 172

P., (U) D.W. Harris

AUTHOR CORP

Army Military Personnel Center (Alexandria, VA)

AVAIL Available from DTIC as AD A155073

DATE 0585

ABSTRACT

The modeling of performance degradation due to chemical protective clothing has become an area of increasing interest to military analysts but has been plagued by a lack of reliable data. This research effort proposes a methodology for estimating the mechanical degradation of individual soldiers when wearing this clothing. With maintenance tasks as the investigative focal point, applicable areas of work measurement, human pr formance, maintenance management and degradation modeling were used to develop the Degradation Analysis Methodology for Maintenance (DAMM). Using a decision model and the appropriate Army technical manual, a taxonomy for maintnenace task analysis divides individual repair jobs into task elements according to their aim and the manual manipulation required. A procedure for obtaining movement degradation values was developed and applied using

field test data. The results were then incorporate into the Ballistic Research Laboratory degraded effectiveness algorithm. DAMM constitutes an improvement over the subjective degradation estimates which predominate in current data bases and does not require costly field testing.

081

TITLE

PSYCHOLOGICAL EFFECTS OF CHEMICAL DEFENSE ENSEMBLE IMPOSED HEAT

STRESS ON ARMY AVIATORS (U), 34 P., (U) B.E. Hamilton, R.R. Simmons and K.A. Kimball Army Aeromedical Research Lab. (Ft. Rucker, AL

AUTHOR CORP REPORT AVAIL

USAARL-83-6

Available from DTIC as AD A121956

DATE 1182

ABSTRACT

Psychological testing was conducted with six Army aviators before and after flights in a UH-1H helicopter while wearing standard flight suits. US or UK aircrew chemical defense ensembles. Additional testing on non-flight days was conducted to provide a baseline for evaluation. Tests consisted of encode/ decode logical reasoning problems, target problems, math problems, detection problems, and a four-choice reaction time test. Tests were scored for number of attempted percent correction reaction time of correct and incorrect responses. Self reports of mood were also taken and scored. The results of the study indicated that various levels of ensemble-imposed heat stress caused orderly changes in psychological function and extended the results of laboratory investigations to the aviation setting. In addition, ...reactime time data ..snowed...changes in the pilot's ability to deal with 'error' situations as a function of imposed stress and that self reports of mood were unreliable indicators of severe heat stress.

082

TITLE

EFFECT OF CHEMICAL PROTECTIVE CLUTHING AND EQUIPMENT ON COMBAT

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EFFICIENCY (U), 85 P., (U)

AUTHOR CORP

J.A. Rakaczky Army Materiel Systems Analysis Activity (Aberdeen Proving Ground,

MD)

REPORT AMSAA-TR-313 Available from DTIC as AD A108575

AVAIL DATE

ABSTRACT

A need for specific, quantitative data pertaining to the degradindividual and unit combat efficiency caused by the wearing of chemical warfare (CW) protective gear, i.e., mask, hood, gloves, overgarment, and overboots. The US Army Materiel Systems Analysis Activity (USAMSAA) has initiated a program designed to provide these data. This report describes the first portion of this program, the development of a viable data base which will enable meaningful and useful degradation data to be generated through employment of computer simulants. Computer simulations are used to evaluate doctrine, training procedures, equipment and occasionally to study current battlefield scenarios. In any future conflict there is the strong possibility that toxic chemical agents will be employed by opposing forces to achieve a tactical advantage. As a result, computer models are being modified or developed to study the effects that

083

TITLE

ADDED AIRWAY RESISTANCE AND ENQURANCE IN INTENSIVE EXERCISE (U),

31 P., (U)

AUTHOR

F.W. Stemler and F.N. Craig

CORP REPORT Edgewood Arsenal (Aberdeen Proving Ground, MD)

chemical warfare will have on military operations.

EB-TR-76040

AVAIL

Available from DTIC as AD A028290

DATE

0776

ABSTRACT

The effects of added sirway resistance on endurance in running on treadmill at 7mph was tested in US Army male volunteers. Various combinations of inspiratory and expiratory resistance were provided by the following respiratory conditions: (A)

standard M17A1 protective mask, (B) modified M17 mask, (C) peripheral M9 mask, (D) M9 mask less filter, (E) mouthpiece and noseclip, and (F) bareheaded control. In a pilot study, conditions (A) and (F) were compared at two grades on the treadmill. The decrement in endurance due to condition (A) was greater at the lower grade. In series 1 and 2, the six conditions were compared at a single grade for each of nine men, including duplicate tests on three of the men. The results were consistent with the hypothesis that the decrement in endurance due to added airway resistance will be small at high and low work rates and will be maximal at some intermediate work rate. The small added airway resistance commonly found in equipment for making various respiratory measurements during exercise can cause a decrement in proportion to the size of the resistance. The results raised the question of whether, in the range of resistances of modern protective masks, the expiratory resistance is more critical than the inspiratory.

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BRIEFING ON THE EFFECTS OF THE PROTECTIVE MASK ON INDIVIDUAL COMBAT SKILLS (U), 19 P., (U)

AUTHOR W. Montague CORP

Human Resources Research Organization (Alexandria, VA)

AVAIL Available from DTIC as AD A020142

DATE 1158

ABSTRACT

The immediate and prionged effects of wearing a protective mask on an individual soldier's combat skills were studied in relation to seven different types of performance--rifle speed, obstacle running speed, clear running speed, rifle hits, binocular target detection, unaided target detection, radio, and driving vigilance. For each activity, one or more objective job-sample tests were constructed or existing tests modified and administered in three separate exploratory studies. Results of the study conducted at Ft. Benning, Georgia with two groups of ten men each indicate (a) the immediate effect of the mask was interference with the combat activities, and (b) men did better, on the average, after they had worn the mask for five hours than they did after five hours unmasked.

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085

EFFECT OF PROPOSED B-1 PROTECTIVE SMOKE HOOD ON VISUAL PSYCHOMOTOR

PERFORMANCE (U), 9 P., (U)

AUTHOR M.K. Ohlbaum and A.T. Kissen

Aerospace Medical Research Lab. (Wright-Patterson AFB, OH)

REPORT AMRL-TR-75-55

AVAIL Available from DTIC as AD A015733

DATE 0875

ABSTRACT Potential in-flight emergencies on contemporary aircraft include smoke in the cockpit even without patent fire. In order to avoid eye irritation, the use of a plastic hood to isolate the face of the aviator from the smoke has been proposed. Investigation of visual psychomotor performance indicates that the hood may be marginally satisfactory for very brief time periods, but compl-

five minutes or more.

086 TITLE

MEASURING THE INTELLIGIBILITY OF SPEECH THROUGH THE PROTECTIVE

etely unsatisfactory and potentially hazardous when work for

MASK (U), 37 P., (U)

AUTHOR CORP

Matanzo

REPORT

TITLE

TITLE

CORP

Edgewood Arsenal (MD)

AVAIL

EA-TR-4343 Available from DTIC as AD 867552L

DATE 0370

087

PHYSICAL PERFORMANCE COMPARISON OF MEN WEARING M17, M22, AND XM28

PROTECTIVE MASKS IN HOT ENVIRONMENTS (U), 17 P., (U)

AUTHOR E.G. Cummings, W.Y. Blevins and C.R. Bulette

		FULL CITATIONS
	CORP REPORT AVAIL DATE	Edgewood Arsenal (MD) EA-TR-4304 Available from DTIC as AD 853404L 0669
088	TITLE AUTHOR CORP REPORT AVAIL DATE ABSTRACT	INSPIRATORY RESISTANCE AS A LIMITING FACTOR IN EXHAUSTING WORK (U), 38 P., (U) F.N. Craig, H.L. Froelich and W.V. Blevins Edgewood Arsenal (MD) EA-TR-4230 Available from DTIC as AD 847373 1068 Although the perception of an external resistance to breathing has a low threshold, men can adapt to large resistances without impairing their capacity to perform submaximal work. When the work approaches the maximal effort, performance may be impeded by the inspiratory resistances encountered in military protective masks. Inspiratory resistances and expiratory resistances were tested in four men who walked to exhaustion with the treadmill up a grade ranginf rom 10 percent to 22 percent.
089	TITLE AUTHOR CORP REPORT AVAIL DATE AESTRACT	DEXTERITY AFFORDED BY CB PROTECTIVE GLOVES (U), 41 P., (U) J.M. McGinnis, C.K. Bensel and J.M. Lockhart Army Natick Labs. (MA) USA-NLABS-TR-73-35-PR Available from DTIC as AD 759123 0373 Three chemical and biological (CB) protective gloves were evaluated and compared to bare hands with regard to their effects on the performance of five manual tasks during 14 daily sessions. One task measured the angular force which could be exerted on a cylindrical handle. Four tasks measured finger or hand dexterity. One of these included the use of wrenches and screwdrivers. On the Torque Test, scores were highest when the butyl rubber CB protective glove was worn and lowest (only 1/3 as large) with the standard cotton CB protective glove. Performances with bare hands and with butyl gloves worn under the leather gloves were between the two extremes and were approximately equal. On all four dexterity tasks, bare hand performance was best and performance was worst when the butyl glove was worn under the leather glove. On these tasks, performances with the cotton glove and the butyl glove were very similar and differed significantly from the extreme conditions. Because of the great impairment on manual dexterity, the butyl and leather glove combination was judged unacceptable.
090	TITLE AUTHOR CORP AVAIL DATE ABSTRACT	EFFECT OF SAFETY GLOVES ON SIMULATED WORK TASKS (U), 69 P., (U) B.H. Weidman Army Materiel Command, Intern Training Center (Texarkana, TX) Available from DTIC as AD 738981 1270 The increasing demand being placed on the human hand to function in new environments requires examination of how performance is affected by the required safety gloves. The objective in this research is to help determine which safety glove or glove types are best suited for particular work situations when there is a choice in the type of safety glove which will satisfy the safety requirements. The performance of ten subjects performing five simulated work tasks under five glove conditions is examined in this report. The five glove conditions consist of barehand and leather, terry cloth, neoprene, and PVC gloves.
091	TITLE	METHOD OF RELATING PHYSIOLOGY AND MILITARY PERFORMANCE: A STUDY OF SOME EFFECTS OF VAPOR BARRIER CLOTHING IN A HOT CLIMATE (U), 14 P., (U)

AUTHOR R.J.T. Joy and R.F. Goldman CORP Army Research Inst of Environmental Medicine (Natick, MA) AVAIL Available from DTIC as AD 672876 Military Medicine, Vol. 133 No. 6, Pp. 458-470, June 1968 SYMURL DATE 0068 ABSTRACT It is our intent to suggest an experimental design which will relate physiological measurements to individual and unit performance during military tasks. It may be summarized as (A) the selection of physiological variables which can be demonstrated to be closely related to clinical or subclinical casualty production, and (B) temporally relating these to the occurrences of individual ineffectiveness in terms of job, unit progress, unit mission, and environmental variables. PERFORMANCE MEASURES FOR HUMAN FACTORS ENGINEERING EVALUATION OF 092 TITLE EARL EQUIPMENT (U), 149 P., (U) CORP Dunlap and Associates, Inc. (Darien, CT) REPORT SSD66-332(618) Available from DTIC as AD 653627 AVAIL DATE 0666 A simple measurement design is inadequate for field testing of teams. Observations must be structured to detect separate **ABSTRACT** patterns of performance across multiple variables, individual team members, and various subtasks. Human observers at the field site cannot alone record this wide range of data at the pace of team performance. Data recording equipment, particularly videorecorders, assure a more adequate and objective data collection. Performance of certain beam tasks, generally those requring individual initiative in cordinating activity, may be significantly altered by the wearing of the protective masks. Other tasks of a repetitive drill nature may be much less affected. Even very meticulous testing during field training activity may fail (because of the 'slack time' and indirect motivations inherent in the practice environment) to reflect validly potential decrements in a tactical environment. For 105-mm howitzer crews specifically, there will probably be no consistently critical performance problems while wearing protective masks, although the team's normal pattern of oral intercommunication is definitely disrupted. 093 TITLE EFFECTS OF PROTECTIVE MASKING UPON SMOKE GENERATOR AND FUEL SUPPLY TEAM PERFORMANCE (AN ANALYSIS OF AN EXPERIMENT CONDUCTED BY THE U.S. ARMY CHEMICAL CORPS) (U), 16 P., (U) AUTHOR R.I. Moren and W.E. Montague CORP George Washington U., Human Resources Research Office (Alexandria, VA) AVAIL Available from DTIC as AD 628146 DATE 0459 ABSTRACT The following conclusions apply to the daylight performance, under cool pleasant weather conditions, of teams thoroughly practiced in their jobs and experienced in wearing the mask: (1) On the average , the decrement in job performance caused by wearing the protective mask is about 5 per cent for smoke generator and fuel supply teams, though specific performance fluctutate widely about this value. (2) When the protective mask is worn for four hours on each of three consecutive working days, there is no evidence to indicate that performance decrement either increases or decreases systematically. Nor is there evidence for any systematic change in the decrement as a result of a subsequent bivouac experience involving 68 hours of masking. TITLE 094 ANALYSIS OF CHEMICAL AND BIOLOGICAL DEFENSIVE EQUIPMENT (U), 46 P., (U) J.G. Colyer **AUTHOR** CORP Air Force Armament Lab. (Eglin AFB, FL)

	REPORT AVAIL DATE	AFATL-TR-72-140 Available from DTIC as AD 522182 0772
	ABSTRACT	The purpose of this work is to investigate the capabilities of Air Force defensive equipment to permit an Air Force installation to maintain an operational capability in a chemical or biological environment. Typical threat environments are hypothesized. The tasks which must be performed on a base are delineated. The adequacy of the various defensive equipment for use in the performance of each task is assessed. Finally, the operational suitability of individual protective equipment is evaluated, that is, does the system not only protect an individual but also allow him to complete his mission. In addition, existing information on Air Force chemical and biological defensive equipment is compiled.
095	TITLE	EVALUATION OF M17 PROTECTIVE MASK MODIFIED TO ACCOMMODATE RESUSCITATION DEVICES: EFFECT ON PHYSICAL PERFORMANCE (U), 19 P., (U)
	AUTHOR CORP REPORT	S.E. Jackson Edgewood Arsenal (MD) EA-TM-115-2
	AVAIL DATE	Available from DTIC as AD 486859L 0766
096	TITLE	EVALUATION OF M17 PROTECTIVE MASK MODIFIED TO ACCOMMODATE RESUSCITATION DEVICES: EFFECT OF TEMPERATURE AND WORK LOAD ON USER PERFORMANCE (U). 13 P., (U)
	AUTHOR CORP	S.E. Jackson Edgewood Artenal (MD)
	REPORT	EA-TM-115-1
	AVAIL DATE	Available from DTIC as AD 486858L 0766
097	TITLE	RESPIRATORY BURDEN OF THE FIELD PROTECTIVE MASK (U), 285 P., (U)
	AUTHOR CORP	W.D. Van Huss and W.W. Heusner Michigan State U., Dept. of Health and Physical Education (East Lansing, MI)
	AVAIL Date	Available from DTIC as AD 470579
	ABSTRACT	Three experiments were undertaken to evaluate the effects of the respiratory burden of the M17 field protective mask during heavy work. Barehanded controls and additional low and high resistance modifications of the mask were also measured. Work tasks included the half-mile run, mile run, continuous treadmill run to exhaustion, standard treadmill run, and intensive interval run to exhaustion. The effects of the various respiratory conditions, warm-up, gas collection, and training upon work performance and selected physiological parameters were evaluated. The conclusions were as follows: (1) performance times in tests of short duration do not differentiate respiratory conditions; in tests of longer duration with a higher aerobic component, the performance times differentiate respiratory conditions. (2) The high respiratory resistance conditions during heavy exercise, the maximal pulse rate, respiratory rate, respiratory minute volume, oxygen intake, oxygen pulse, and in very heavy work the respiratory quotient; (3) training under high resistance conditions elicits adaptive mechanisms, as yet unidentified which reduce sensitivity to resistance conditions and enhance performance.
098	TITLE	DEVELOPMENT OF A METHODOLOGY FOR MEASURING INFANTRY PERFORMANCE IN DIGGING HASTY FIGHTING POSITIONS (U), 60 P., (U) [Partial report

	CORP AVAIL DATE ABSTRACT	Dunlap and Associates, Inc. (Darien, CT) Available from DTIC as AD 467159 O665 This report describes the work performed to develop a reliable method for measuring soldier performance in this task. Procedures were established for measuring performance in the task. Procedures were establishe for measuring performance in the excavation of a simulated foxhole and tested for reliability and sensitivity to differences in clothing and equipment using USAGETA Troops. Four possible test methods were evaluated and a modified test situation with an automatic data collection system is recommended for inclusion in an integrated field course to be evaluated as the next step in the research program. The method selected involves the prestressing of participants with three 100-yard dashec after which the times to excavate specified weights of earth are recorded.
099	TITLE	DEVELOPMENT OF METHODOLOGY FOR MEASURING INFANTRY PERFORMANCE IN GRENADE THROWING (U), 49 P., (U) [Partial report no. 5 oh Phase 2] A. Gruber, G. DeNittis, J.W. Dunlap, J.L. Sanders and V.W. Perry
	CORP AVAIL DATE	Dunlap and Associates, Inc. (Darien, CT) Available from DTIC as AD 467158 O665
	ABSTRACT	A three-phase research effort is underway to develop field methodology for measuring the effects of experimental clothing and equipment on the combat effectiveness of individual infantrymen. The first partial report in this series reported work performed to identify and rank the relative importance of the physical tasks performed in combat by the individual infantryman. Onc of the tasks which was considered by a sample of combat veterans to be important to combat success was the ability to throw hand grenades accurately in various battle situations. This report describes the work performed to develop a reliable method for measuring performance in throwing grenades at both horizontal and vertical targets. A proposed test course was established as a temporary facility and tested for reliability and sensitivity to differences in clothing and equipment using USAGETA Troops. It was determined that the tested course provided a practical and useful basis for measuring performance in the task and a modified data collection system was recommended for inclusion in an integrated course to be evaluated as the next step in the research program.
100	TITLE	DEVELOPMENT OF A METHODOLOGY FOR MEASURING THE INFANTRY PERFORMANCE IN MANEUVERABILITY (U), 75 P., (U) [Partial report no. 3 on Phase 2] A. Gruber, J.W. Dunlap, G. DeNittis, J.L. Sanders and V.W. Perry
	CORP AVAIL DATE ABSTRACT	Duniap and Associates, Inc. (Darien, CT) Available from DTIC as AD 467157 O665 This report describes the work performed to develop a reliable method for measuring soldier performance in the essential ingredients of this task under conditions considered representative of combat conditions. A proposed test course was established as a temporary facility and tested for reliability and sensitivity to differences in clothing and equipment using USAGETA Troops. It was determined that the events comprising the tested course provided a practical and useful basis for measuring the maneuverability of individual soldiers. A modified data collection system is recommended for an integrated field course to be evaluated as the next step in the research program.
101	TITLE	DEVELOPMENT OF A METHODOLOGY FOR MEASURING INFANTRY PERFORMANCE IN RIFLE FIRING AND RELOADING (U), 2 P., (U) [Partial report no. 2 on Phase 2]

102

103

AUTHOR A. Gruber, J.W. Dunlap and G. DeNittis CORP Dunlap and Associates, Inc. (Darien, CT) Available from DTIC as AD 466881 AVAIL DATE 0665 ABSTRACT A three-phase research effort is underway to develop field methodology for measuring the effects of experimental clothing and equipment on the combat effectiveness of individual infantrymen. This report describes the work performed to develop a reliable method for measuring soldier performance in the essential ingredients of these tasks under conditions considered representative of combat conditions. A proposed method was tested using a modified Train Fire Range. Trials on the temporary facility demonstrated that the proposed system was sensitive to performance differences resulting from personal equipment worn, such as gloves and gas masks. A refined system is recommended for inclusion in a field course for evaluation in Phase 3 of the project. TITLE IDENTIFICATION OF IMPORTANT TASKS OF COMBAT INFANTRY. REPORT OF RESULTS FROM A FURTHER REFINEMENT. PHASE II. DEVELOPMENT OF METHODOLOGY FOR MEASURING EFFECTS OF PERSONAL CLOTHING AND EQUIPMENT ON COMBAT EFFECTIVENESS OF INDIVIDUAL SOLDIERS (U), 64 AUTHOR A. Gruber, J.W. Dunlap and J.L. Sanders CORP Dunlap and Associates, Inc. (Darien, CT) Available from DTIC as AD 452787 AVATL DATE 1164 A three-phase research effort is underway to devilop field **ABSTRACT** methodology for measuring the effects of experimental clothing and equipment on the combat effectiveness of individual infantrymen. In order to develop a meaningful measurement system, it was necessary to identify the physical tasks performed by infantrymen in combat and to determine the relative contribution of the various tasks to combat success. The results of a preliminary study conducted under phase ${\bf I}$ of the project were refined using 311 veterans of U.S. Army operations in Vietnam, Korea, and both the European and Pacific theaters during the World War II. The veterans independently rated the relative importance of 27 selected combat tasks using a triad comparison technique. The sample of individuals were screened for relevancy of their combat experience, (and for the self-consistency and sensitivity of their ratings, leaving a final sample of 208 highly qualified raters. A high degree of agreement was found among veterans from the same and from different theatres and a reliable ranking of the relative importance of 27 definable combat tasks was established. TITLE DEVELOPMENT OF A METHODOLOGY FOR MEASURING EFFECTS OF PERSONAL CLOTHING AND EQUIPMENT ON COMBAT EFFECTIVENESS OF THE INDIVIDUAL FIELD SOLDIER (U), 119 P., (U) AUTHOR A. Gruber, J.W. Dunlap and G. DeNittis CORP Dunlap and Associates, Inc. (Darien, CT) AVAIL Available from DTIC as AD 429887 DATE 0264 Recent developments in conventional and exotic weapon systems are creating urgent needs for new types of protective clothing and **ABSTRACT** devices. While this protection may enable the soldier to survive in an otherwise fatal environment, it imposes certain physical, physiological, and psychological stresses and limitations such that his ability to protect himself against other weapons, to move, or to take aggressive action may be severely limited. The ultimate goal of the project is a field measurement system that will provide objective data regarding the effects of personal

clothing and protective equipment on the combat effectivness of

the individual infantry soldier.

104	TITLE	TEST FLIGHT OF PILOTS' FLASHBLINDNESS HELMETS, GOGGLES, GLASSES AND ASSOCIATED SYSTEMS (U), 28 P., (U)
	AUTHOR	E.P. Jacobs
	CORP	Naval Air Test Center (Patuxent River, MD)
	REPORT	NATC-ST35-40R-63
	AVAIL	Available from DTIC as AD 414688
	DATE	0863
	ABSTRACT	Explosively actuated flashblindness protective helmet and goggles and associated systems were evaluated in laboratory and flight tests to determine comfort, wearability,, and effect on a pilot's capability to perform his mission. The ELF lens and electrical control unit components were not satisfactory for service use. The lens evidenced poor dimensional control and was subject to leakage; failures of electrical contact unit occurred. Other components were satisfactory. The helmet size range was inadequate; an extra large size helmet is necessary for proper fitting of some objects. Other deficiences reported should be corrected and the modified equipment be submitted for evaluation.
105	TITLE CORP	OPERATIONS IN A TOXIC ENVIRONMENT (U), 160 P., (U) Army Combat Developments Command, Experimentation Comman (Ft.
	REPORT	Ord, CA) USACDCEC-60.3
	AVAIL	Available from DTIC as AD 392322
	DATE	0468
	ABSTRACT	The report evaluates the effects of ABC toxic-protective mask, hood, and gloves on: (1) the target-detection and fire-adjustment performance of artillery and mortar forward ground observers who are wearing the toxic-protective equipment; (2) the fire-effectiveness of a 7-man Basic Infantry Element while the 7 man are wearing the toxic-protective equipment. The report is based on two experiments that were conducted in day and night conditions, with and without the use of passive night vision devices.
106	TITLE	PSYCHOLOGICAL ASPECTS ROAD BATTALION OPERATIONS IN A TOXIC ENVIRONMENT (U), 104 P., (U)
	AUTHOR	J.K. Arima
	CORP	Army Combat Developments Command, Experimentation Command (ft. Ord, CA)
	REPORT	CDCEC-63-4
	AVAIL DATE	Available from DTIC as AD 371768 0964
	ABSTRACT	This technical report covers all aspects of the psychologic
	ABSTRACT	evaluation which was conducted as a part of the operational capability experiment (Vol. 1). Data collected during all aspects of the experiment were used for the analysis in Section 2 of the report, Effects of Prolonged Wearing of Chemical Protective Clothing as a Function of Individual Personality Characteristics.
107	TITLE	ROAD BATTALION OPERATIONS IN A TOXIC ENVIRONMENT. VOL. 1, OPERATIONAL CAPABILITY EXPERIMENT (U), 357 P., (U)
	CORP	Army Combat Developments Command, Experimentation Command (Ft. Ord, CA)
	REPORT	CDCEC~63-4-Vol.1
	AVAIL	Available from DTIC as AD 371766
	DATE	1263
	ABSTRACT	This report evaluates the effects imposed by a continuous toxic chemical environment on the operational capabilities of reinforced ROAD infantry and mechanized infantry battalions whose personnel wear standard chemical protective clothing and equipment. The experiment was conducted in four phases. Individual phase in two parts, (1) Panama, to evaluate effects of a hot/humid environment, (2) Fort Ord, CA, to evaluate small arms

firing performance; and the last two phases, element and Battalion, conducted at Hunter-Liggett Military Reservation. In all phases, two different combinations of standard chemical protective clothing and equipment were worn, open suit and closed suit. Normal combat clothing was also worn as a basis for performance comparison.

108	TITLE	EFFECTS OF WEARING THE CBR PROTECTIVE MASK UPON THE PERFORMANCE OF SELECTED INDIVIDUAL COMEAT SKILLS (U), 37 P., (U)
	AUTHOR	W.E. Montague, R.D. Baldwin and A.H. McClure
	CORP	George Washington U., Human Resources Research Office (Alexandria, VA)
	REPORT	HUMRRO-TR-57
	AVAIL	Available from DTIC as AD 220171
	DATE	0659
109	TITLE	TACTICAL CHEMICAL-BIDLOGICAL OPERATIONS STUDY; ADDENDUM STUDY PROJECT MANDRAKE ROOT; VOL. 1, MAIN REPORTANNEX A (U), 650 P., (SRD)
	CORP	Army Combat Developments Command, Chemical-Biological-Radiololgical Agency (Ft. McClellan, AL)
	AVAIL	Available from DTIC as AD 399097L
	DATE	C667
110	TITLE	TACTICAL CHEMICAL-BIOLOGICAL OPERATIONS STUDY; ADDENDUM STUDY PROJECT MANDRAKE ROOT; VOL. 2, ANNEXES B THROUGH E (U), 707 P., (SRD)
	CORP	Army Combat Developments Command, Chemical-Biological-Radiololgical Agency (Ft. McClellan, AL)
	AVAIL	Available from DTIC as AD 399098L
	DATE	0667
111	TITLE	TACTICAL CHEMICAL-BIOLOGICAL OPERATIONS STUDY; ADDENDUM STUDY PROJECT MANDRAKE ROOT; VOL. 3, ANNEXES F THROUGH H (U), 434 P., (SRD)
	CORP	Army Combat Developments Command, Chemical-Biological-Radiololgical Agency (Ft. McClellan, AL)
	AVAIL	Available from DTIC as AD 399099L
,	DATE	0667
112	TITLE	AVIATION PERFORMANCE ASSESSMENT IN A CHEMICAL ENVIRONMENT (APACHE); VOL. 1 (U), 700 P., (U)
	CORP REPORT	Army Combat Developments Experimentation Command (Ft. Ord, CA) CDEC-TR-83-002A
	AVAIL	Available from DTIC as AD 8073007L
	DATE	0383
	ABSTRACT	This report provides data to astuss the degree of degradation, if any, in Attack Helicopter Team performance attributed to conducting extended combat operations while wearing the Chemical/Biological (CB) protective ensemble. The results of this Force Development Test and Experimentation (FDTE) will be used by the Army Aviation Center (USACVNC), Army Chemical School (USACS),
		Army Human Engineering Laboratory (USAHEL), and Army Materiel Systems Analysis Agency (USAMSAA) to support assessment of aviation chemical operations, assist in development of doctrine, and in making force development recommendations.
113	TITLE	AVIATION PERFORMANCE ASSESSMENT IN A CHEMICAL ENVIRONMENT (APACHE); VOL. 2, TEST REPORT (U), 556 P., (U)
	CORP REPORT	Army Combat Developments Experimentation Command (Ft. Ord, CA) CDEC-TR-83-0028
	AVAIL	Available from DTIC as AD B072964L
	DATE	O383

TITLE 114

DEGRADED EFFECTIVENESS STUDIES FOR MAJOR DEVELOPMENTAL SYSTEMS AND HIGH DENSITY ITEMS (U), 46 P., (U)

AUTHOR

J.J. Baldauf and C.H. Wick

CORP

Army Ballistic Research Lab. (Aberdeen Proving Ground, MD)

REPORT BRL-TR-2680

AVAIL DATE ABSTRACT Available from DTIC as AD A160475

0985

Soldier performance when operating military systems while wearing chemical protective clothing at the most protective level, Mission Oriented Provective Posture (MOPP) level IV is a vital concern to commanders. The analysis of a soldier's degraded effectiveness provides insight into the interrelationships, between these systems and the operators. Fourteen Army systems were identified by USANCA for evaluation of compatibility, these were missions for: M1E1 tank, M-3 Bradley, XM270 Multiple Launched Rocket System, M249 squad Automatic Weapon, AH64 Advanded Attack helicopter, HMMWV High Mobility Multi-Purpose Wheeled Vehicle, Grade, XM21 Chemical Monitoring System, AN/-VDR-2 Radic Set, MEDBN aid station, SINGARS, MCS and the PLRS. Twelve-hour Mission Profiles were developed from related documents for each system. Critical tasks were extracted from these Profiles and divided into their respective time-action components. The BRL Chemical Protection Degradation Model was used to evaluate the degraded effectiveness of individuals and teams performing the specific tasks at MOPPIV. Degraded effectiveness factors were tabulated for each system by task, Factors were determined for 45 different tasks. One task which affects missions is radio communication, which is degraded to U.30. Road

movement was found to be moderately degraded (0.87) where fire

were degraded to approximately 0.50. It is felt that a number of modifications of equipment and redesign of the MOPP ensemble may result in improved compatibility and a number of specific recommendations are made. The results of this study provide recommendations are made. The results of this study provide valuable data to the battlefield commander for evaluating the penalties he must endure because his troops must wear the MOPPIV gear while performing mission critical tasks. Further, the recommendations for improvements are valuable guidelines to the

instrument reading functions

115 TITLE RESILIENCY OF AMMUNITION SUPPLY POINTS IN A PRE-DEFINED. INTEGRATED BATTLEFIELD SCENARIO (U), 121 P., (S-NOFORN)

AUTHOR CORP REPORT M.M. Stark and J.T. Klopcic

material developer.

Army Ballistic Research Lab. (Aberdeen Proving Ground, MD)

BRL-TR-2609

AVAIL DATE ABSTRACT Available from DTIC as AD C036303L

missions, loading activities and

1184

the results of a subsequent analysis of the This report presents resiliency of an ASP to a pre-defined, integrated battlefield scenario using inputs already established, including examining the effects of conventional, chemical and nuclear units on eight distinct ASPs. The result includes the effectiveness of each of these ASPs subjected to this scenario, a casualty assessment for each unit, and several excursions of interest. These excursions included an assessment of the sensitivity of the baseline results to assumptions made in regard to RED targeting capabilities and how effectively personnel can operate on MOPP gear.

APPENDIX

THERMAL STRESS REDUCTION

01	TITLE AUTHOR CORP	AN ICE-COOLING GARMENT FOR MINE RESCUE TEAMS (U), 19 P., (U) M.I. DeRosa and R.L. Stein Bureau of Mines, Pittsburgh Mining and Safety Research Center (Pittsburgh, PA)
	REPORT	BUMINES-R1-8139
	AVAIL	Available from NTIS as PB 254 487
	DATE	0576
02	TITLE	CONTROL OF THERMAL BALANCE BY A LIQUID CIRCULATING GARMENT BASED ON A MATHEMATICAL REPRESENTATION OF THE HUMAN THERMOREGULATORY SYSTEM (U), 561 P., (U)
	AUTHOR CORP	L.H. Kuznetz National Aeronautics and Space Administration, Lyndon B. Johnson Space Center (Houston, TX)
	REPORT	NASA-TM-X-58190 \$ USC-11579
	AV4IL DATE	Available from NTIS as N77-19756
03	TITLE AUTHOR	USE OF A VORTEX TUBE IN SAFETY CLOTHING (U) J.F. Ham
	SYMURL DATE	Archives of Environmental Health, Vol. 10, Pp. 619-623, April 1965 0065
04	TITLE	PERSONAL COOLING WITH DRY ICE (U)
	AUTHOR Symure	S. Konz, C. Hwang, R. Perkins and S. Borell American Industrial Hygiene Association Journal, Vol. 35 No. 3,
		Pp. 137-147, March 1974
	DATE	0074
05	TITLE	ICE-COOLING GARMENT FOR MINE RESCUE TEAMS (U), 13 P., (U)
	AUTHOR CORP	M.I. De Rosa and R.L. Stein Bureau of Mines (Pittsburgh, PA)
	REPORT	CIS-76-2007 \$ BUMINES-RI-8139
	DATE	∞76
06	TITLE	EFFECTIVENESS OF FOUR WATER-COOLED UNDERGARMENTS AND A WATER-COOLED CAP IN REDUCING HEAT STRESS (U) G.F. Forence
٠	SYMURL	Aviation, Space and Environmental Medicine, Vol. 47 No. 11, Pp.
	DATE	1159-1164, November 1976 0076
07	TITLE	EFFICACY OF PRESSURE SUITE COOLING SYSTEMS IN HOT ENVIRONMENTS (U)
07	AUTHOR	J.H. Veghte
	SYMURL	Aerospace Medicine, Vol. 36 No. 10, Pp. 964-967, October 1965
	DATE	0065
08	TITLE	PHYSICAL ASPECTS OF MICROCLIMATE SUITS (U)
	AUTHOR Symurl	N.B. Strydom, D. Mitchell, A.J. Van Rensburg and C.H. Van Graan Tunnels and Tunnelling, Vol. 5 No. 5, Pp. 482-484, October 1973
	DATE	0073
09	TITLE	DESIGN AND EVALUATION OF A PERSONAL DRY-ICE COOLING JACKET (U)
	AUTHOR	J. Duncan and S. Konz
	CORP Symurl	Human Factors Society (Santa Monica, CA) Proceedings of the Human Factors Society 19th Annual Meeting,
		Human Factors in Our Expanding Technology (Papers presented
	DATE	14-16, 1975), Pp. 359-363, October 1975 0075
10	TITLE	LABORATORY COMPARISON OF PORTABLE COOLING SYSTEMS FOR WORKERS EXPOSED TO TWO LEVELS OF HEAT STRESS (U), 22 P., (U)
	AUTHOR	D.M. Terrian and S.A. Nunneley
	CORP	Aerospace Medical Division (AFSC), Air Force School of Aerospace Medicine (Brooks AFB, TX)

THERMAL STRESS REDUCTION

	DEDOOT	HEAFEAM-TD-92-44
	REPORT DATE	USAFSAM-TR-83-14 0783
11	TITLE	EVALUATION OF AN AIR-COOLED VEST IN REDUCING HEAT-STRESS OF
	AUTHOR	SOLDIERS IN CHEMICAL PROTECTIVE CLOTHING (U) N.A. Pimental, T.H. Tassinari, B.S. Cadarette, M.N. Sawka, G.N.
	CORP	Sexton, V.D. Iacondo and M.B Pandolf Army Research Institute of Environmental Medicine, Natick Research
	SYMJRL	<pre>and Development Center (Natick, MA) Aviation Space and Environment Medicine, Vol. 55 No. 5, P. 456-456, 1984</pre>
	DATE	0084
12	TITLE	HEAD COOLING IN WORK AND HEAT STRESS (WATER COOLED HEAD CAP FOR HEAT STRESS AMELIORATION IN SUBJECTS WORKING IN WARM ENVIRONMENTS) (U)
	AUTHOR CORP	S.A. Nunneley, Ur. Troutman S.J. and P. Webb Onio State U., Columbus OH and Webb Associates (Yellow Springs, OH) A
	AVAIL Symurl Date	Available from AIAA Technical Library Aerospace Medicine, Vol. 42, Pp. 64-68 O171
13	TITLE	EFFECTIVENESS OF FOUR WATER COOLED UNDERGARMENTS AND A WATER COOLED CAP IN REDUCING HEAT STRESS (U). 30 P (U)
	AUTHOR	G.F. Fonseca
	CORP	Army Research Institute of Environmental Medicine (Natick, MA)
	REPORT AVAIL	USARIEM-T-23/76 Available from DTIC as AD A025216; Available from NTIS as
		N77-12696; Available from AIAA Technical Library
	DATE	1275
14	TITLE	PERSONAL COOLING SYSTEM FOR HELICOPTER PILOTS (U), 14 P., (U)
	AUTHOR	S.M. Reeps
	CORP REPORT	Naval Air Development Center (Warminster, PA) NADC-77289-60
	AVAIL	Available from DTIC as AD A047649; Available from NTIS as
	DATE	N78-18767; Available from AIAA Technical Library 1177
15	TITLE	USE OF A WETTED COVER TO REDUCE HEAT STRESS IN IMPERMEABLE CLOTHING (U), 38 P., (U)
	AUTHOR	J.R. Breckenridge
	CORP REPORT	Army Research Institute of Environmental Medicine (Natick, MA) USARIEM-T-7/80
	AVAIL	Available from DTIC as AD A094322: Available from NTIS as
	DATE	N81-18648; Available from AIAA Technical Library
	55.0	
16	TITLE	AUXILIARY COOLING -COMPARISON OF AIR-COOLED VS. WATER-COOLED VESTS IN HOT-DRY AND HOT-WET ENVIRONMENTS (U)
	AUTHOR	Y. Shapiro, K.B. Pandolf, M.N. Sawka, M.M. Toner, F.R. Winsmann and R.F. Goldman
	CORP	Army Research Institute of Environmental Medicine (Natick, MA)
	AVAIL	Available from AIAA Technical Library
	SYMURL	Aviation, Space and Environmental Medicine, Vol. 53, Pp. 785-789, August 1982
	DATE	0882
17	TITLE	EFFECTIVENESS OF FIVE WATER-COOLED UNDERGARMENTS IN REDUCING HEAT STRESS OF VEHICLE OPERATING IN A HOT WET OR HOT DRY ENVIRONMENT (U), 50 P., (U)
	AUTHOR	G.F. Fonseca
	CORP REPORT	Army Research Institute of Environmental Medicine (Natick, MA) USARIEM-T-2/81
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THERMAL STRESS REDUCTION

		THERMAL STRESS REDUCTION
	AVAIL	Available from DTIC as AD A203469; Available from NTIS as N82-26994; Available from AIAA Technical Library
	DATE	0381
18	TITLE	DEVELOPMENT OF MICROCLIMATE COOLING SYSTEM FOR COMBAT VEHICLES (U), 33 P., (U)
	AUTHOR	V.D. Iaconi, J.S. Cohen, M. Kupsinskas, D. Gorbea and J. Fratantuono
	CORP	Army Natick Development Center, Individual Protection Lab. (Natick, MA)
	REPORT	NATICK/TR-82/010 \$ IPL-248
	AVAIL	Available from DTIC as AD A112017; Available from NTIS as N82-27989; Available from AIAA Technical Library
	DATE	0282
19	TITLE	EFFECTIVENESS OF ICE (WATER) PACKETS VESTS IN REDUCING HEAT STRESS (U), 44 P., (U)
	AUTHOR	G.F. Fonseca
	CORP	Army Research Institute of Environmental Medicine (Natick, MA)
•	REPORT AVAIL	USARIEM-T-3/82 Available from DTIC as AD A117864; Available from NTIS as
	WAVIE	N82-34021; Available from AIAA Technical Library
	DATE	0382
20	TITLE	MICROCLIMATE COOLING FOR COMBAT VEHICLE CREWMEN (U), 14 P., (U)
	AUTHOR	R.F. Goldman
	CORP	Army Research Institute of Environmental Medicine (Natick, MA)
	AVAIL	Available from DTIC as AD A117156; Available from NTIS as N82-34083; Available from AIAA Technical Library
	SYMURL Date	Presented at the Army Science Conference, 15-18 June 1982 0682
21	TITLE	EFFECTIVENESS OF WATER COOLING UNDER PROTECTIVE CLOTHING AT TEMPERATURES BETWEEN 22 C AND 55 C (U)
	AUTHOR	S.A. Konz, Jr. Rohles F.H. and E.A. McCullough
	CORP	Kansas State U., Institute for Environmental Resugrich (Manhattan, KS)
	AVAIL	Available from AIAA Technical Library Research Institute of National Defense International Conference on
	SYMURL	Protective Clothing Systems, Pp. 215-221
	DATE	0183
22	TITLE	LABORATORY COMPARISON OF PORTABLE COOLING SYSTEMS FOR WORKERJ EXPOSED TO TWO LEVELS OF HEAT STRESS (U), 23 P., (U)
	AUTHOR	D.M. Terrian and S.A. Nunneley
	CORP	School of Aerospace Medicine (Brooks AFB, TX)
	REPORT	SAM-TR-83-14
	AVAIL	Available from DTIC as AD A131848; Available from NTIS as N84-12423; Available from AIAA Technical Library
	DATE	0783
23	TITLE	EFFECTIVENESS IN REDUCING HEAT STRESS OF THREE CONDITIONED-AIR COOLING VESTS WORN WITH AND WITHOUT COOLING AIR SUPPLIED TO A FACE PIECE (U), 42 P., (U)
	AUTHOR	G.F. Fonseca
	CORP	Army Research Institute of Environmental Medicine (Natick, MA)
	REPORT	USARIEN-T-1/83
	AVAIL	Available from DTIC as AD A131975; Available from NTIS as N84-12726; Available from AIAA Technical Library
	DATE	0383
24	TITLE	HEAT STRESS RELATED TO THE OPERATION OF CANADIAN FORCES AIRCRAFT -A HISTORICAL REVIEW AND POSSIBLE SOLUTION (U)
	AUTHOR	C.J. Brooks, A.G. Hynes, L.V. Allin and L.A. Kushn
	CORP	SAFE Association (Van Nuys, CA) and Defence and Civil Institute of Environmental Medicine (Toronto, CA) U

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	ORIGIN	Canada
	AVAIL	Available from AIAA Technical Library
	SYMURL	Proceedings, SAFE Association, Annual Symposium, 20th, Las Vegas, NV, Pp. 91-94, December 6-10, 1982
	DATE	0083
25	TITLE	PHYSIOLOGICAL REACTIONS OF MEN USING MICROCLIMATE COOLING IN HOT HUMID ENVIRONMENTS (U)
	AUTHOR	A.J. van Rensburg, D. Mitchell, WH van der Walt and N.S. Strydom
	ORIGIN	England
	SYMURL	Br J Ind Med (England), 29 (4), Pp. 387-393, October 1972
	DATE	0072
26	TITLE	AUTOMATIC CONTROL OF HUMAN THERMAL COMFORT BY A LIQUID-COOLED GARMENT (U)
	AUTHOR	L.H. Kuznetz
	SYMURL	J Biomech Eng. 102 (2), Pp. 155-161, May 1980
	DATE	0080
27	TITLE	HEAT AND/OR TORSO COOLING DURING SIMULATED COCKPIT HEAT STRESS (U)
	AUTHOR	S.A. Nunneley and R.J. Maldonado
	CORP	Air Force School of Aerospace Medicine (Brooks AFB, 7X)
	SYMJRL	Aviation Space Environ Med. 54 (6), Pp. 496-499, June 1983
	DATE	0083

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